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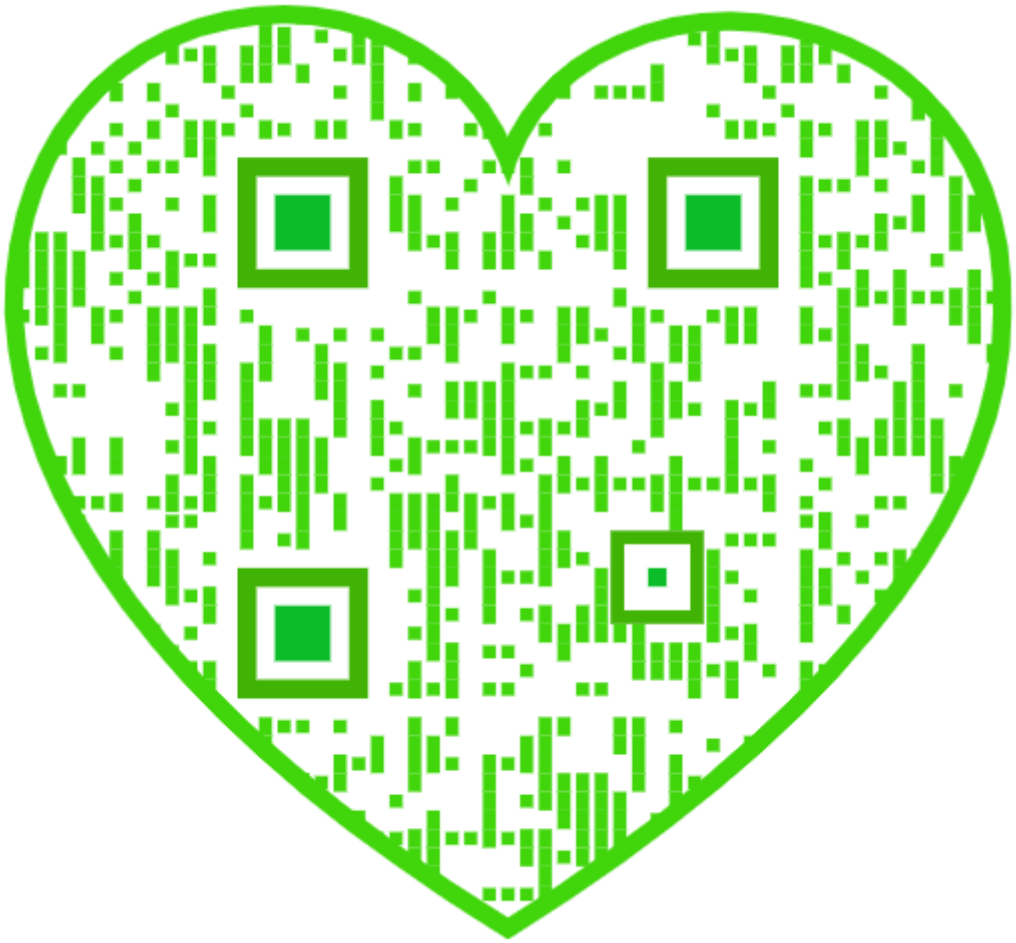
WEAVING PLAIN AND FANCY

NELSON



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WEAVING—PLAIN AND FANCY.

BY

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PREFACE.

The writer hopes that the description and operation of the various motions on the looms as described in this book will prove beneficial to all interested in this subject.

THOMAS NELSON.

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WEAVING—PLAIN AND FANCY.

CHAPTER I.

PLAIN LOOM.

Shedding.—The first principal movement in weaving is "Shedding." A cloth consists of two series of threads, warp threads and filling threads. The warp threads are drawn through the harness and the harness are raised in a certain order. In a plain cloth one harness is raised and the other lowered. This opening or separating of the threads is to enable the shuttle to pass through them and lay in the filling. This is known as the "Shed."

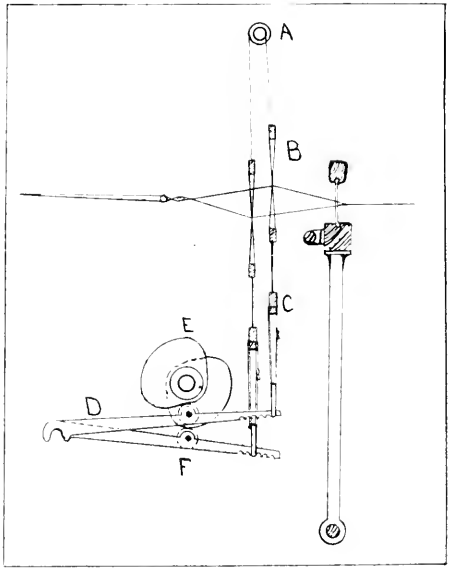

Fig. 1.

Names of Parts in Shedding Motion.—A sketch of the shedding motion is given at Fig. I. The parts are as fol-

lows: A, collar or boss on harness roller. B, harness connected to roller by harness straps. C, jack sticks. D, treadles fulcrumed on back girt of loom and connected to harness by straps and hooks. E, shedding cams. F, treadle ball. Notice.—Collar on harness roller is of two distinct sizes. Front harness is connected to smallest part of collar. Back harness to largest part of collar. It is absolutely necessary to connect back harness to largest part of collar because back harness being farther away from fell of cloth (fell of cloth is last pick of filling put in cloth) has to travel a greater distance than front harness to make same size of shed.

Shedding Cams.—One shedding cam is also larger than the other. The back harness is connected to the treadle which the largest cam operates. The reason for this is the same as given for collar on roller, viz, back harness travels farther than front harness; also the back harness is connected to the treadle nearer the cams, consequently nearer the fulcrum than the front harness, and for this reason a larger cam is necessary to equalize the size of shed.

There are in use practically three distinct kinds of shedding cams, viz, one-third, one-half, two-thirds dwell cam. The meaning of the term dwell is as follows: In one full revolution of the cam the harness are stationary for that portion of the revolution; therefore that portion of revolution of crank shaft. The one-third dwell cam can only be used on narrow looms. They are of service when tender or poor yarns have to be woven because of the even movement given to the harness when changing. As there is only a small amount of dwell the cams must be set on correct time with the picking motion. If not set on time poor selvages will result. A smaller shuttle has often to be used with these cams so as to get clear through the shed on time. The best practical cam that can be used is the one-half dwell cam.

This has advantages over the one-third dwell cam. The harness are stationary one-half revolution of crank shaft, which gives sufficient time for the shuttle to get clear through the shed. There is one-half revolution of crank shaft to change the harness. With a well constructed cam the harness will run almost as easy as the harness with a one-third dwell cam. Cover can be put on the cloth because the filling can be beaten up in an open shed. On wide looms a two-third dwell cam is often used. The harness are stationary for two-thirds of a revolution of crank shaft. This leaves only one-third of a revolution to change the harness for next pick, consequently a sudden movement is given to the harness, which has a tendency to strain the yarn. The harness are soon worn out. Soft or tender yarns can not be used with this cam.

Setting Harness Connections.—When cams are level, the harness roller, harness and treadles must also be set level. In setting the harness roller level care must be taken so that when the harness opens the straps will not lap under on the collar, or an uneven, jerky motion will result. The harness must be set so that when the shed is open the threads will not rest on the race plate, or the continued backward and forward movement of the lay will soon chafe them. They must be just low enough to prevent chafing. If the threads are too high from the race plate the shuttle will have a tendency to fly out.

The harness must also be set level at both ends, viz, one side must not be higher or lower than the other. The cams should be set to work full on the treadle balls and not to one side of them; they should also be in contact with the balls for the whole revolution. Poor setting of the harness will cause faulty cloth, not only this but the cost of manufacturing the cloth is increased, and even if passable cloth is made the expense of harness is a considerable item. If

the harness are set too close to the lay, the lay coming in contact with them will soon cut them.

Timing of Shedding Cams.—Cams should be set level when crank is just past bottom center. There are several reasons for this timing. A better "cover" can be put on cloth because filling will be beaten into the cloth in an open shed. The filling can also be driven into the cloth easier. If cams are set later than this on heavy goods, selvages are apt to break.

Relative Cams and Shuttles.—It is advisable to have relative cams, that is to say, a cam that would be suitable for very coarse yarns would not be suitable for very fine yarns. The reason is obvious. Fine yarns require only a small shed, coarse yarns a large shed. On fine yarns only small cops or bobbins are made in filling, so that only a small shuttle need be used, consequently only a small shed made. A good size of shuttle for filling, say, over 80 or 100 counts, is 1 1-2 inches wide, 1 1-4 inches deep. On fine goods the principal point is quality, but on coarse goods the principal point is quantity; therefore as large a shuttle should be used as possible, consequently a large shed will be required. For ordinary coarse goods, a good size of shuttle would be 1 5-8 inches wide 1 3-8 inches deep.

To Obtain Size of Shed.—Having a set of cams in the loom, to obtain the size of shed the cams will give. Example: Length of treadle from fulcrum to point of connection with front harness 22 inches. Distance from fulcrum to treadle ball 14 inches. Stroke of cam 3 inches. Distance of front harness from fell of cloth 7 1-2 inches. Front of shuttle to fell of cloth 3 1-2 inches. What will be the size of shed? 22x3÷14 equals 4.714 inches, distance through which front harness moves. 4.714x3.5÷7.5 equals 2.2 inches, size of

shed. A shuttle about 1 3-8 inches deep would be used for this size of shed. The difference between the actual figures and the size of shuttle used is accounted for in the loss with straps and connections, the loss amounting to about three-quarters of an inch.

To Obtain Stroke of Cam That Will Give a Required Size of Shed.—Example: Depth of shuttle 1 1-4 inches. Distance from fell of cloth to front of shuttle 3 inches. Distance from fell of cloth to front harness 6 inches. Harness connected to treadle 22 inches from fulcrum. Distance of treadle ball from fulcrum 14 inches. What is the stroke of cam required? First allow three-quarters of an inch for loss. 6x2÷3 equals 4 inches, distance moved by front harness. 4x14÷22 equals 2.5 inches, stroke of cam required.

PICKING.

The second principal movement in weaving is "Picking." The proper adjustment of the picking mechanism is of the utmost importance if satisfactory results are to be obtained. It is this motion that causes so much power to be required to run a loom. The force of the blow required to drive the shuttle across the lay is known as the "power," and it is the reduction of this power that all fixers strive to attain. When too much power is used the result is that a greater amount of supplies are required, owing to picker sticks being broken, pickers and straps worn out, besides the extra trouble and attention that is necessary.

Description of Picking Motion.—The picking motion on a cotton loom is generally what is known as the "cone" pick. This motion consists of the following parts: Fixed on the pick cam shaft in the loom is a pick cam. Above this cam a cone is supported from a picking shaft, this shaft being held to the side of the loom by two pick shaft boxes. On the oppo-

site end of the shaft the picking arm is attached and extends downward. Passing around the bottom of the picking arm is a short lug strap which is in turn connected by a sweep stick to a long lug strap that passes around the picker stick. This lug strap is held up on the picker stick by a stirrup strap. To the bottom end of the picker stick a heel strap is fixed, the end of the strap being connected to a spiral spring which draws the picker stick back to its original position after picking.

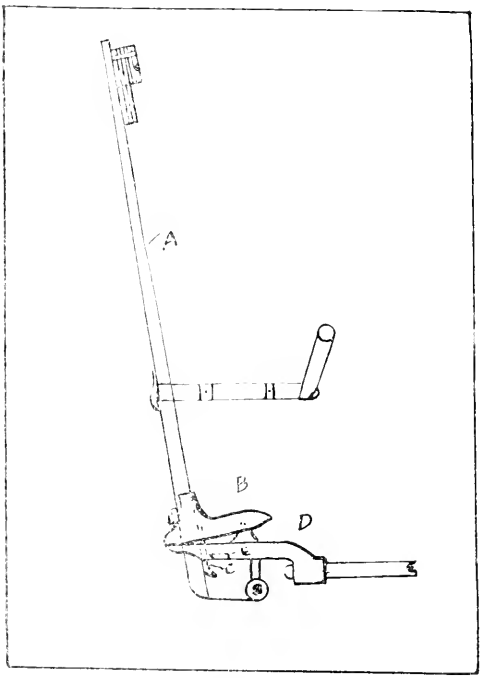

Fig. 2.

Parallel Motion.—Fig. 2 is a sketch of the parallel motion. A, picker stick. B, parallel. C, parallel tongue. D, picking stand. E, plug. This motion is one of the most important parts of the picking motion. The object of this

motion is to enable the picker to travel parallel the full length of the stroke. The picking stand is level, but the parallel is curved. The shape of parallel is obtained by using the picker as a center and the distance from picker to end of parallel as a radius. The parallel should work full and free on the picking stand, and should not work to one side, or the small projection on the picking stand will soon be worn away and the result will be that the picker stick cannot be worked to the best advantage. The plug, which is inserted in the picking stand, must have the face perfectly true or this will cause the parallel to move to one side and cause shuttle to fly out. In picking, the tongue forms a tapering contact with plug.

Setting the Pickers.—The picker should be fastened securely to the picker stick. To set the picker have the picker stick to the back end of box. Put on the picker to its right position and push shuttle full into the box so that an impression will be made in face of picker. Cut a small hole where impression is made. If this hole is not made, the shuttle is apt to strike in different places, but by making the hole, shuttle will strike true and be delivered better. Excellent results are obtained if the hole is cut from one-sixteenth to one-eighth of an inch higher. Under no circumstances must the hole be made lower or the shuttle will be continually flying out. Picker must not be too low when shuttle is being delivered or shuttle will certainly fly out. A piece of leather inserted between parallel tongue and picker stick or between tongue and parallel will elevate the picker at delivery. If picker is too high when delivering shuttle, a piece of leather inserted underneath the parallel between picker stick and tongue will reduce the elevation. On some looms a set nut is used so that any change in elevation can very readily be made.

Picking Cams.—These cams should be constructed so as to give a gradual movement to the shuttle, that is, a gradual development of speed. The shuttle should begin slowly, and gradually increase in speed until full power is applied, which will be when shuttle is about leaving picker. These cams are shaped so that from about the back of the cam opposite the pick point there is a cut off or a gradual tapering inwards almost to the pick point. Some picking cams are circular in construction and have a large pick point. These circular cams are generally keyed on the shaft, adjustment in timing of picking being made by moving the pick point backward or forward. When possible to do so, it is advisable to set the pick cams on a new loom, so that the end of pick point will be flush with the outer edge of the picking cone. After the loom has been in operation some time and the cone and cam wear, it is sometimes necessary to move the cam in nearer the side of loom in order to obtain the power required.

Timing of Picking Motion.—The timing of picking motion is to have the shuttle begin to move when crank is on top center. The motion is set on this time because the shed will be open to receive the shuttle, also the shuttle will have time to get through the shed before shed begins to close. If the picking is set earlier than this, the shuttle will have to force its way into the shed, and this will chafe the yarn and break the selvages. Another reason is given under heading, "Relation of timing of picking motion to beating up."

Picking Cones.—As the name implies, these are cone shape and correspond to the bevel on the periphery of the picking cam. The cone is not fixed directly over the center of the picking cam, but a little behind the center, so that when the pick point comes in contact with the cone, the cone is raised easily and without any undue strain on the pick shaft boxes. If the cone should be set directly over the center of picking

cam a great strain would be put on the front pick shaft box. The picking motion should be set so that the cone will drop on the cam immediately after picking and travel around the cam until it is picked again. Sometimes this motion is set and the cone does not drop on the cam immediately after picking, but only comes in contact with it just previous to picking. This occasionally causes a weak pick to be made, and should be remedied. When picking, the cone should be full into the pick point so as to receive the full benefit of the blow. Occasionally a pick point is not properly constructed, and when picking only one side of the pick point is in contact with the cone, so that much of the power is lost. The cone should also be set so as not to be too high or too low at the back, as this has some bearing on the fitting of picking cone to pick point.

Setting Lug Straps.—These straps should be set to avoid extremes in power. To illustrate: To make a stronger pick the stirrup strap is lowered on picker stick or the picking arm is lowered. To make a weaker pick the stirrup strap is raised on picker stick or the picking arm is raised. The desired result is obtained by manipulating the picking arm and stirrup strap, but if the picking arm is set at its lowest, which is the strongest point, and the stirrup strap at its highest, which is the weakest point, the best results would not be obtained. There would be extra power on the picking arm, but it would be lost on account of the stirrup strap being high on the picker stick. This fixing would also cause trouble to the fixer as the screw that holds the stirrup strap would be continually coming out. It is therefore better, when possible to do so, to have the lug straps as near level as possible to conform to practical results. This will enable a change to be easily made for a stronger or weaker pick. The picking cam should be set to begin picking, so that there will not be too

much play between the lug strap and picker stick, as this causes lost motion and weak picks.

Setting Picker Stick.—There are two methods of setting picker stick. First, to have stick return to back end of box after picking. Second, to have the stick remain three or four inches in the box from the back, after picking. To fix the picker stick for first method, have the heel strap at bottom of picker stick about level with the spiral spring connected with heel strap. To fix picker stick for second method, have the heel strap at bottom of picker stick, about one inch higher than the connection of heel strap with spring; or another way of fixing for this method is to have the heel strap between the parallel tongue and picker stick. Both these methods have their adherents. In the second method, the picker stick being three or four inches in the box will act as a check on the shuttle.

Binders or Swells.—The purpose of the binder is to hold the shuttle firm in shuttle box, also to act as a check on the shuttle as it is entering the box. There are practically two kinds—one made from mallable iron, the other from wood. The first can be bent to any shape required, but the best shape is to have the binder gradually tapered so as to grip the shuttle about half way. This shape will also gradually check the shuttle as it is entering the box. The wood binder has generally a shoulder on the end nearest the entrance to the box. If this shoulder is too pronounced the shuttle will receive a sudden check. The sudden striking of the shuttle on the binder causes the protector finger that presses against the back of the binder to jump, and the binder, being suddenly released, the shuttle shoots into the box. To overcome this the box must be kept tight or a good shuttle check used. Another disadvantage of this kind of binder is when using short shuttle boxes. If a weak pick should be made the shuttle

would enter the box sufficiently to press out the binder and clear the dagger from the frog. The opposite end of the shuttle would probably be extended in the shed with the result that when the lay revolves a smash would be made.

BEATING UP.

The third principal movement in weaving is "beating up the filling." This is an eccentric movement, as will be noticed on reference to Fig. 3.

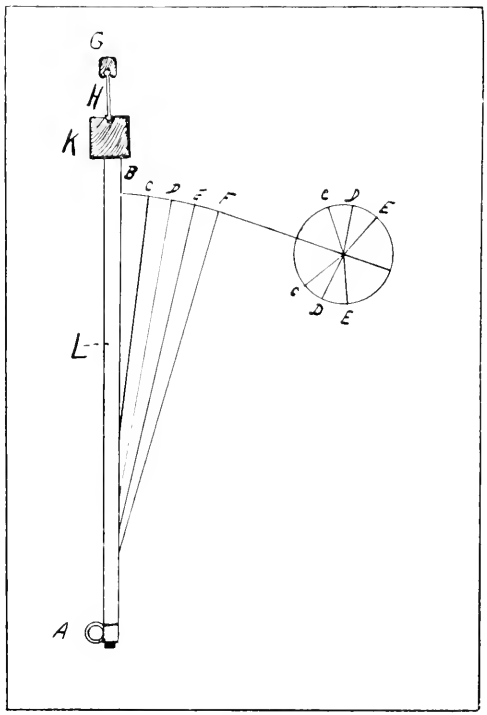

Fig. 3.

This figure illustrates the lap cap, G; reed, H; lay sole, K; lay sword, L; with connecting pin B, which connects the

crank arm with the lay, in different positions, while the crank is making one revolution. With lay sword at A B, the crank is on front center. A C, position of lay when crank is at C.A D, position of lay when crank is at D.A E, position of lay when crank is at E.A. F, position of lay when crank is at back center. From this it will be seen that the front half of the stroke is made in less time than the back half, or, in other words, the lay moves quicker in traveling from B to D and back again to B than it does in traveling from D to F and back again to D. A quick beat-up is therefore given to the filling.

Relation of Timing of Picking Motion to Beating Up.—As stated in "Picking" the timing of picking motion is to have shuttle begin to move when crank is on top center. It will be noticed in Fig. 3 that when crank is at this point the lay is traveling at its highest speed. As the crank moves towards the back center the speed of lay is considerably reduced. The shuttle is therefore being delivered when lay is at its highest speed, but the speed of shuttle decreases before it passes clear through the shed. The speed of the lay is also decreased and this gives the shuttle time to get clear through the shed and into the opposite box. It is not advisable to set the picking motion earlier than top center for the following reason: If the shuttle is picked from box before crank reaches top center the lay will not have attained its highest speed, and as the shuttle is passing across the lay there will be a tendency for the lay to leave the shuttle behind. This will cause the shuttle to have ridges or furrows on the back and will also cause it to rattle in the box.

CHAPTER II.

ADDITIONAL MOTIONS AND PARTS.

Auxiliary Shaft.—Looms that are constructed to weave plain goods have the shedding cams on the pick cam shaft. Other looms are constructed so as not only to weave plain goods but also twills and sateens. On these looms the shedding cams are placed on an auxiliary shaft so that the cams can be changed for the different class of goods that have to be made. This shaft is run at different speeds according to the cams being used. A fixed gear is set on the auxiliary shaft, but on the pick cam shaft are a set of gears, each gear when meshed into the gear on auxiliary shaft will alter the speed of this shaft.

Example.—Plain cloth to be made. Gear on auxiliary shaft 60 teeth. The gear on pick cam shaft will require to be the same size as gear on auxiliary shaft since auxiliary shaft has to travel the same speed as pick cam shaft, viz: one revolution of auxiliary shaft to two revolutions of crank shaft. When twill or sateen cams are put on auxiliary shaft the speed of that shaft will have to be reduced in proportion to the number of cams on shaft. This is done by changing the gear on pick cam shaft. If a five harness twill or sateen has to be made the speed of auxiliary shaft will have to be reduced so that five picks can be inserted in the cloth for one revolution of auxiliary, or, in other words, the crank shaft will make five revolutions to one of auxiliary shaft. To ascertain gear required to drive auxiliary shaft use the following rule: (a) Multiply gear on end of pick cam shaft by gear on auxiliary shaft. (b) Multiply gear on end of crank shaft by picks required in one revolution of auxiliary shaft.

Example.—A loom has to be changed over from plain

cloth to five harness twill. Gears on loom as follows: On end of crank shaft, 35 teeth; one end of pick cam shaft, 70 teeth; on auxiliary shaft, 60 teeth. What size gear will be required? 70x60÷35x5 equals 24-tooth gear. By substituting in rule the gear which is meshed into gear on auxiliary shaft the number of picks in one revolution of auxiliary shaft can be found.

Example.—Gear on end of crank shaft, 35 teeth; on end of pick cam shaft, 70 teeth; on pick cam shaft driving gear on auxiliary shaft, 30 teeth; on auxiliary shaft, 60 teeth. How many picks in one revolution of auxiliary shaft? 70x60÷35x30 equals four picks. A four-harness twill can be made with this gearing.

Changes Required.—When changing over from plain goods to twills or sateens several changes have to be made. These are as follows: New cams; gear to drive auxiliary shaft; additional jack sticks and straps; additional treadles; new harness rollers. If a vibrating whip roll had been used for the plain goods it would be advisable to reduce the leverage for the following reason: The vibrating whip roll is used to relieve the strain on the yarn when the harness are open, for at this point the greatest strain is on the yarn. This vibrating whip roll is therefore more desirable for plain goods than for twills or sateens, because one-half the yarn in plain cloth is raised and the other half lowered at the same time. In twills and sateens some harness are changing while others are stationary so that good results are obtained by reducing the vibration.

Timing of Twill or Sateen Cams.—When two harness shafts in twill or sateen are being changed—one raised the other lowered—that is, at the time they are crossing each other, have the crank shaft just past bottom center. The timing of this motion can often very easily be changed as an

intermediate or carrier gear is used to transmit motion from the gear on pick cam shaft to gear on auxiliary shaft. By moving this carrier gear out of position the cams can be set at any desired point in relation to crank shaft.

Tape Selvage.—A tape selvage is often used on twills and sateens. This is to obtain a good flat selvage. When the selvage threads are drawn through the same harness shafts as the sateen it is almost an impossibility to get a good selvage, as the threads will roll or curl under. This is owing to the fact that the outside thread is not caught by the filling on every pick. In the tape selvage two picks are put in a shed before a change is made. The driving gear for this motion is fixed on the pick cam shaft and is meshed into another gear, which has twice as many teeth in it. This gear is fixed on a small shaft, which is supported by two brackets. On each end of the shaft is a set of small plain cams, which operate the heddles for tape selvage. One revolution of the tape motion cam shaft equals four picks, two picks for each cam. This is calculated the same as for auxiliary shaft. As this motion enables two picks to be put in before a change is made, the cams must be set so that when one side is on first pick the other is on second pick; in other words, the cams must be set to change the selvage heddles alternately on each side.

Protectors.—There are two kinds of protectors, viz, side protector and center protector. When binders are at back of shuttle box a side protector is used, but when at front of shuttle box a center protector is used. A protector is necessary on every loom because it prevents smashes. The protector is worked from binder in shuttle box. When shuttle is in box, the binder is forced out, which in turn forces out the protector finger. On side protector the protector dagger is raised and passes over the frog and loom continues to run. If shuttle

should not get in the box the protector dagger would not be raised and would consequently strike the frog, which would immediately stop the loom. Two frogs are generally used, the frog on shipper handle side has a knock off finger bolted to it, which is directly behind the shipper handle when loom is running, and when the dagger strikes the frog the shipper handle is immediately forced out of position, and at the same time the brake, which is connected to the frog, is pulled against the tight pulley and loom is stopped. The frog on opposite side of loom is known as the "dead" or "blind" frog, and prevents the lay from swinging forward at that side, also to equalize the strain on the loom. The daggers are set so that both will strike the frogs at the same time; if anything, the live frog should be just a trifle ahead of the other.

A center protector has only one dagger, which is in center of protector rod. The frog or receiver is a long iron, bolted loosely under the breast beam, one end being behind the shipper handle, the other end directly opposite the dagger. When shuttle is in box the dagger passes under receiver. If shuttle should fail to get in box, the dagger would strike the receiver and shipper handle would immediately be forced out of position and loom stopped. To set the protector, have the receiver in position it will be when loom is running. Set dagger in groove in the receiver. Set the protector fingers against binders. In setting, care must be taken not to have any lost motion between finger and binder, also be sure that the dagger strikes full in slot in the receiver.

Filling Stop Motion.—The filling stop motion is for the purpose of stopping the loom when the filling runs out or is broken. This motion consists of an elbow lever that works on a stud fixed to the side of the loom. One end of the elbow lever extends over the pick cam shaft, the opposite end is at

right angles, and extends upwards under the filling fork. A cam fixed on the pick cam shaft gives a forward and backward movement to the elbow lever. The filling fork slide works in a stand on the breast beam. A lever is fulcrumed on the extreme end of the shipper handle casting; this lever is behind the shipper handle, one end fitting either in the filling fork slide or behind the slide. When the loom is running, the filling is laid directly in front of a grate that is in line with the reed and back of shuttle box. As the lay comes forward the filling will raise fork out of the way of elbow lever and loom will continue to run. When the filling is broken, the fork passes through the grate, and the elbow lever, in moving outwards, comes in contact with the hook on end of fork. This forces back the filling fork slide and at the same time forces back the shipper handle and loom is stopped.

Setting Fork.—In setting the fork, care must be taken that the prongs of the fork pass clear into or through the grate, and must not come in contact whatever with the grate, but must work clear, so that when filling breaks the end of fork will remain over the elbow lever. When the fork is raised, the bottom of the prongs must work free in the slot in lay sole. Fork must not be set too far through the grate; it is only necessary to pass just through. This will be regulated by the size of filling used.

Shape of Fork.—The prongs on the fork can be made any desired shape. It is advisable, however, not to have the bottom of the prongs protruding or standing out too far from the bend, as they will have a tendency to catch the filling. One of the best shapes is to have them almost straight from the bend to the end of prongs, being bent in somewhat near the bottom end, or, in other words, slightly concave. With this shape there is less liability of the filling catching on the

ends of prongs, also the prongs do not need to pass as far through the grate. Care must be taken not to have the prongs too short, and all must be the same shape. Very fine filling only requires a light fork, but a heavy filling requires a heavy fork.

Timing of Filling Stop Motion.—Have shuttle in box at stop motion side with crank on front center or a little beyond. Push stop motion slide as far forward as it will go. At this point the stop motion cam should be set so that the elbow lever will be just passing under the hook on fork.

Thin Place Preventor.—On all cotton looms there is a thin place preventor. These are differently constructed, but the object is the same on all, viz, to raise the catch on take-up gears when filling breaks, which prevents the gears from drawing down the cloth for those picks where no filling is inserted. If this motion is not set right the gears will take up without any filling being inserted in the cloth, and when the loom is started a thin place results. It is well to notice if any of the fingers have slipped; if so, they will have to be put back to their right position.

Take Up Motion.—This motion consists of a train of gears and a roller, around which the cloth passes. The roller is generally covered with perforated tin and draws down the cloth as the picks are being inserted. The perforations prevent the cloth from slipping. Each loom maker has a special train of gears. If the ratchet gear is driven from the pick cam shaft each tooth in the change gear represents two picks. To put any number of picks per inch in the cloth the change gear will have half the number of teeth. If the ratchet gear is driven from the lay sword each tooth in the change gear represents one pick, so that to put any specified number of picks per inch in the cloth that number of change gear would

be used. If the change gear is meshed directly into the gear on take up roller the number of teeth in change gear does not represent the number of picks per inch put in cloth, and calculation has to be made for same.

To Obtain Change Gear for a Certain Number of Picks.—Multiply the number of teeth in take up ratchet by number of teeth in take up roller gear, and by 2 for a dividend. Multiply circumference of take up roller in inches by picks required per inch for a divisor. Divide dividend by divisor and the quotient will be number of teeth in pick gear.

Example.—What change gear will be required to put in cloth 64 picks per inch? Ratchet gear 110 teeth. Take up roller gear 68 teeth. Circumference of take up roller $12\frac{1}{4}$ inches.

$$110\text{x}68\text{x}2 \div 64\text{x}12.25 = 19 \text{ teeth in change gear.}$$

Let Off Motion.—There are two kinds of let off motions in general use, friction let off and gear let off. The commonest friction let off is a rope passed around the drum on the beam head and attached to a weight lever under the beam. Sufficient weight is required on the lever to keep the yarn tight. As the beam is reduced in size some of the weight is taken off. It is customary in some mills to use a chain instead of a rope. This chain gives very good results and is not effected by the weather. In damp weather when rope is used it becomes sticky and the yarn is not let off even; but if this let off is attended to, good results can be obtained. With the gear let off the yarn is released regularly. This motion is somewhat complicated, but good results are obtained from it. The motion consists of the following parts: A clutch lever connects a spring rod to the whip roll. On the spring rod are two springs, a long one and a short one. An upright shaft works on a stud fixed to the side of the loom. The top of the shaft is on the short end of the spring rod and is held

between the spring and a collar. To the bottom of the shaft is fixed a round iron rod that is connected to the pawl lever. A small pawl is fixed on the end of the pawl lever to turn the ratchet. This pawl is kept in contact with the ratchet by a small spring. Connected to the lay sword is another rod, the opposite end working free on the pawl lever rod. This rod comes in contact with a collar set screwed on the pawl lever rod and turns the ratchet gear, thereby letting off yarn.

Setting the Motion.—Have the whip roll a little higher than the harness eyes, with clutch lever as near perpendicular as possible. The large spring on spring rod should have sufficient pressure on it to keep the yarn tight. The pressure on this spring will be determined by the amount of yarn on beam. The small spring should not be close or tight. When the harness are level the upright shaft should be perpendicular and the pawl lever should be on the outside of the ratchet. When the harness are opening there is a slight forward movement of the upright shaft. This should bring the collar on pawl lever rod almost in contact with the end of rod connected to lay sword, and at the same time the pawl will have moved over the required teeth in the ratchet. In beating up, the pawl lever rod will be pulled forward and the ratchet will be turned. When the reed is about one inch from the fell of the cloth have the collar on pawl lever rod in contact with the rod connected to lay sword. Every part of the motion must work freely; there must be no binding whatever.

Temples.—Temples are for the purpose of keeping the fell of the cloth as wide as the yarn in the reed. If temples were not used the selvages would not weave. The most vital part of the temple is the roll. The Dutcher Temple Co. manufacture rolls for any kind of work, fine or coarse, in different widths to suit the cloth being made. The rolls should always work free; if they do not the teeth will make small holes in the

sides of the cloth. Sometimes it is necessary to take out the rolls to clean them. Care is required when replacing, so that the rolls will not be turned. On many of these rolls there is only one way to fit them in the temple so that it is an impossibility to get them in wrong. This is a decided improvement, for when these rolls are turned, the cloth is not held securely in the temples, the result is that the selvages are continually breaking out. In many cases they will not work at all as the cloth slips out of the temple. Another form of temple is the ring temple. This temple is divided into small sections; each section can be taken out separately. This is one of the best temples for strong, heavy work.

Setting the Temples.—The temples should be fixed securely to the breast beam. The trough of the temple should be just above the race plate. The selvage of the cloth should be full into the temple. When the reed is between one-eighth to one-quarter of an inch from fell of cloth the heel of temple should be in contact with lay.

Lease Rods.—These rods are for the purpose of separating the yarn and obtaining, as the name indicates, a "lease." This using of lease rods enables the weaver to readily find the place if a thread should be broken; the threads can also be kept straight, which is of great service, especially when colored yarns are used. (In England and on the Continent these rods are often called "shed" rods.) A clearer "shed" is obtained by the use of them; they also keep the threads from becoming tangled. A soft wood, with surface insufficiently protected, should not be used; as the continual drawing of the threads over the rods soon cuts little ridges or furrows in them. This is a source of constant trouble and expense, as the threads getting in the ridges are continually breaking out, especially on fine yarns. Such rods have then

to be sand-papered frequently, so as to make and keep them smooth. To overcome this difficulty, a lease rod made from either basswood or white birch, thoroughly seasoned and kiln-dried, then enameled with a special enamel designed and made for this purpose, and the enamel carbonized and thoroughly baked on the rods for several successive coats under high heat for hours, produces a hard, glazed surface, over which the thread or yarn runs as smoothly as over glass;—so made they wear for many years. This makes an exceptionally good lease rod and is known as the Standard "Peerless" enameled lease rod, made by the American Enamel Company, Providence, R. I.

Lease rods are of different sizes and shapes. One is round and the other oval. The largest rod, which is the round one, is always inserted in the yarn first and is the back rod. The back harness is raised and the front lowered when this rod is inserted. When the front or oval rod is inserted the front harness is raised and the back harness lowered. The reason for this is as follows: When the back harness is lowered and the front harness raised, the "shed" opens at a point between the rods. The added thickness of the back rod is sufficient to put the necessary strain on the yarn to make a clear "shed." When the front harness is lowered and the back harness raised, the shed is formed at the front rod. The back harness has to travel a greater distance than the front harness to make the same size of shed because it is farther away from fell of cloth, therefore, more tension is required on the threads drawn through that harness so as to make a clear "shed." This additional tension is obtained by having the threads under the front lease rod, which is sufficient to equalize the distance between the harness and fell of cloth. A small or oval rod is therefore necessary for front rod, as the larger the rod the farther the yarn has to bend.

On many dobby cloths lease rods are not used, as previously stated, but what is known as "clamp" rods are used. These clamp rods are similar to ordinary front lease rods, or they can be square. They are not inserted between the warp threads as are lease rods, but are clamped or held together with the warp threads passing between them at a point about six or eight inches behind the harness shafts. This enables a clear shed to be made.

Shuttles.—On single box work the usual custom is to have two shuttles to one loom, so that when one is at work the other is threaded up ready for use. Both shuttles should be of the same weight and size, so that when the power and shuttle box is set for one shuttle it will also be right for the other. In placing the shuttle in loom, the spindle hinge end is often put towards loom pulley. The eyelet is always on front of shuttle in loom. Shuttles can be right-hand or left-hand. Opinions differ as to what constitute the hand of a shuttle. The most accepted custom is to have the shuttle eyelet farthest from the body, and if eyelet is on right-hand side it is a right-hand shuttle, and vice-versa. Often black marks are made in the cloth a certain distance from the selvage. This is generally caused by the side of the shuttle being black or the shuttle box not being clean. The place where filling is being marked can be found by measuring distance from selvage to marks in cloth, and then using this measure from selvage to box. These marks are called "shuttle marks," as it is generally the shuttle that makes them.

Cover on Cloth.—Cover on cloth is a soft, downy surface, which is distinctly noticeable in a well made plain cotton cloth. When a cloth has a good cover on it, it will at once be seen, and there is also a soft feel to the cloth. The difference between a covered cloth and one which is generally known as "bare" or "reedy" is very distinguishable. A reedy cloth is

entirely void of cover. The threads are drawn two in a dent, and these two threads run together, causing the reed marks to be distinctly visible. For this reason reedy cloth is often called "two-ey."

The warp line, viz. the line formed by the warp from whip roll through harness and reed to cloth on breast beam, has considerable influence in forming either reedy or covered cloth. When the harness are level, if the warp line forms a straight line there will be an equal tension on the threads, both top and bottom, when the harness are opened. This will cause the two threads in each dent to run together and reedy cloth will be the result. If the warp line is below a straight line at the harness when they are level, a certain amount of cover will be put on face of cloth. With this setting, when the harness are open the lower half of the warp will be tight while the upper half will be comparatively slack. When the filling is beaten up into the cloth it is forced more on the face and the slack threads are spread in between the tight threads. The filling, being soft twisted, will give the soft feel to the cloth. Cover on cloth can be increased by raising whip roll or breast beam. Placing a strip of wood on breast beam will answer the purpose. It is necessary to have the shedding cams set early, so that the filling can be beaten up in an open shed. A good setting for cams is to have them level when crank is just past bottom center.

CHAPTER III.

FIXING POINTS.

Under this head will be given the different causes of the loom being out of order and remedies for same.

LOOM BANGING OR SLAMMING OFF.

This is what a fixer is called for in quite a number of cases. There are quite a number of causes for this, which will be enumerated.

Change of Atmosphere.—If there has been a sudden change from dry to damp weather the boxes and shuttles will become sticky. The shuttle will not fit right in the box, and the result will be that the loom will bang off. To remedy: take waste and wipe shuttles and boxes thoroughly dry. If this does not remedy take a piece of fine sand-paper and rub the shuttle. It is advisable to rub both the shuttles the same so as to keep them the same width and weight. A very small drop of oil put on the swell with the finger, after cleaning with waste, will often remedy.

Rebounding Shuttles.—First, caused by pick being too strong. Second, loose box. Third, finger on protector rod having slipped. These can be remedied as follows: First. It can be often seen from which side of the loom the pick is too strong, as the shuttle often stops on that side of the loom with strong pick. The reason for this is, the shuttle having rebounded in opposite box, on the next pick a weak pick is made because of the loss of the initial movement in picking, and the shuttle will not get into the box and loom bangs. Second. If box is too loose, the swell or guide will have to be tightened to hold the shuttle firm in box. Third. If finger on protector rod has slipped, it will have to be put back in right position and tightened securely. In fixing the finger in its

right position care must be taken that the dagger will clear the frog; also that the dagger will strike frog full in the slot.

Cracked or Part Broken Lug Strap.—Do not try to fix up a lug strap that is part broken or cracked, but replace with a new one.

Cracked Picker Stick.—It is not necessary that the picker stick be actually split; if it is cracked a weak pick is likely to result, and it is best to replace with a new one immediately.

Worn Pick Point.—If the point is badly worn, the best remedy is to replace with new one.

Bolt Loose that Fixes Stick to Shoe.—This makes a weak pick, owing to lost motion. Remedy is to tighten up the bolt.

Heel Spring too Tight.—The power that ought to be used to drive the shuttle across the lay is spent in pulling against the spring.

Lost Motion in Cone.—This is caused by neglecting to oil the cone, with the result that the cone wears and becomes loose on its stud and a weak pick often results.

Shedding Cams too Early.—If shedding cams are set too early, the shed will be closing before the shuttle gets full across the lay, with the result that the shed is often closed on the back end of the shuttle and the shuttle is tilted as it enters the box. The result is that the shuttle does not get full into the box and the loom bangs off. This also causes the shuttle to be chipped, and the tip is also often blunted.

Shedding Cams too Late.—If shedding cams are set too late, the shuttle will enter the shed before it is full open, and will be retarded in its movement and the loom often bangs off.

Loom Gears Worn.—This causes the loom to bang off occasionally. The teeth of the gears become worn just where the

picking takes place and this causes lost motion. To remedy this the gears are moved forward. The shedding and picking motions will also require to be put on right time when this is done.

Belt Slipping.—A slipping belt often causes loom to bang. The belt should be cleaned and a good belt dressing applied.

LOOM STOPPING.

The essential difference between loom banging and loom stopping is that in loom banging the loom stops with a jar, while in loom stopping the shipper handle is moved out of the stand and the loom stops easily. Some of the causes of loom banging will also cause loom to stop.

Rebounding Shuttle.—A shuttle rebounding will cause loose filling. This will not raise the fork and the loom is stopped.

Filling Catching on Fork.—A rebounding shuttle will also cause this. Filling sliding up and down on fork when fork is through grate. To remedy this two or three notches are made in the prongs just about where the filling should be held. These notches must not be sharp or they will cut the filling. The best shape of fork has been referred to in previous chapter.

Not Sufficient Friction on Filling in Shuttle.—If there is not sufficient friction on filling in shuttle, the filling will be slack, and will not raise the fork. A piece of flannel or felt inserted near the eyelet in shuttle will generally overcome this defect. On some shuttles there are three eyelets, and if the filling is put through these, slack filling will be prevented.

Fork Too Far Through the Grate.—This will cause the fork to be lifted too high, and the result is that after dropping, the fork rebounds and the hook on the fork is caught

by the elbow lever and the loom is stopped. This occasionally causes the filling to become slack and catch on the fork.

Elbow Lever Too High.—Occasionally the elbow lever is set too high. This causes the fork to rest on the lever and causes a rebound, when it is then caught by the lever on its outward movement and the loom is stopped.

Stop Motion Cam Too Early.—If the cam is set too early the elbow lever comes in contact with the hook on the fork before the fork has been raised, and loom is stopped.

Stop Motion Cam Too Late.—If the cam is set too late the fork will have been raised and have dropped back again in time to be caught by the elbow lever and loom is stopped.

Stand for Shipper Handle Worn.—If the shipper handle stand is worn it will have to be filed so that the shipper handle will fit securely in it.

Shipper Handle Spring Weak.—There is a half turn in some shipper handles and this sometimes becomes weak and the shipper handle slips out of the stand. By strengthening the spring in handle this will be overcome.

Occasional Rubbing of Dagger Against Frog or Receiver.—When the lay comes forward to beat up the filling the dagger should make a full clearance of the receiver. Sometimes the dagger rubs against the receiver, not enough to make the loom bang off, but enough to gradually push off the shipper handle. This can easily be seen by looking at the end of the dagger, which will be bevelled and polished. To remedy this the dagger will have to be reset. In resetting the dagger have receiver in the position it will be when loom is running, bring lay forward and have dagger full in receiver. The fingers on dagger shaft should be set against the swells. When shuttle is in box the end of swell should be clear from box, about one-half to three-quarters of an inch. In setting

the dagger, if the receiver is not in the position it will be when loom is running, but is back from that position, the dagger will strike too high and will cause a smash.

SHUTTLE FLYING OUT.

Overfaced Reed.—In an overfaced reed the ends of the reed are not level with the back of the box, and this causes the shuttle tip to be turned outwards.

Underfaced Reed.—This will also throw out the shuttle. The back of the shuttle will be chipped as it is entering the box. This also causes a crooked running shuttle. A steel straight edge should be used to ascertain if the reed is in line with the back of the box.

Shed Too Late.—If the shed is too late there is not sufficient space for shuttle to enter and the shuttle flies out.

Shed Too Early.—This also causes shuttle to fly out. The shed closing on shuttle before entering the box will throw shuttle out.

Picker Too Low.—If the picker is too low at the back end of the box, also when shuttle is being delivered, the shuttle will almost certainly fly out. It is advisable to have the hole in picker where shuttle strikes, a trifle higher than tip of shuttle when shuttle is in box. The shuttle will run with tip of shuttle in center of hole in picker with the shuttle perfectly level on race iron, but better results are possibly obtained by having the hole elevated from one-sixteenth to one-eighth of an inch. Under no circumstances must the hole be too low. If the picker is too low when delivering the shuttle the outer end of shuttle is tilted and shuttle will strike the mouthpiece of opposite box or fly out. To remedy this, put a piece of leather between the picker stick and parallel tongue, which will elevate the picker at the end of

stroke when shuttle is being delivered from box. Some of the causes of loom banging will also cause shuttle to fly out, especially rebounding shuttle.

UNEVEN CLOTH.

Rope on Friction Let Off Binding.—The rope on friction let off often binds in damp weather, as it becomes sticky, owing to dampness, and the yarn is not let off evenly. The rope should be taken off and thoroughly cleaned, then a little French chalk or powdered black lead sprinkled on the rope and the beam will work easy. Powdered black lead is the most expensive, but is the best, as only a little need be used at a time. Tallow is sometimes used, but this does not give as good results as either French chalk or powdered black lead. The ropes soon become sticky again, owing to dust and flyings accumulating on them. Oil is sometimes dropped on the rope by the weaver; this will also cause dust and lint to accumulate and rope will have to be cleaned.

Take Up Gears Too Tight.—If the take up gears are too tight they will lock and uneven cloth will result.

Small Pinion Gear Too Deep in Beam Head.—This will cause the yarn to be let off unevenly, and if there should be any small chips of iron between the teeth on beam head this will cause the beam to jump. The beam heads should be examined and all small chips taken out.

Weak Spring Behind Let Off Pawl.—If the small spring behind the pawl is weak, the pawl will slip over some teeth occasionally, causing yarn to be let off unevenly. It is advisable to look out for this, for if the spring should break the yarn will not be let off at all and a smash will result.

Harness Straps Lapping Under.—If the harness straps

lap under each other a jerky motion is given to the harness, and this causes streaks in the cloth, especially on fine work.

BAD SELVAGES.

Many times cloth is rejected on account of bad selvages, even though the body of cloth is perfect. There are quite a number of causes for this.

Not Sufficient Friction on Filling in Shuttle.—If there is not sufficient friction on filling in shuttle it is likely to curl up on selvage.

Filling Catching on Picker.—If the picker is worn and has rough places on it the filling will catch, and this will prevent the filling from going in the cloth, and the loose end will hang outside the selvage.

Filling Catching on Lay Sole.—When the shuttle is leaving the box there is always a certain amount of loose filling. This loose filling sometimes gets in front of the lay sole and is caught there. This is generally seen in narrow cloths where there is plenty of space left between the sides of cloth and the boxes. This can often be overcome by tacking a piece of smooth leather to the front of the lay sole between the sides of cloth and the boxes.

Harness Too Low on One Side.—This will also cause a poor selvage, as the yarn will sag at that side and the filling will cling to it.

Filling Fork Prongs Too Short.—If the prongs of the fork are too short the filling will catch on them, and when this filling breaks it will hang loose at the side of cloth or will be pulled in the cloth. Often when filling catches on fork, the loom is stopped; in other cases the loom continues to run after filling in shuttle is broken.

Too Much Friction on Filling in Shuttle.—If there is too much friction on filling in shuttle the selvage will be pulled in and this will cause a poor looking cloth. This will also have a tendency to make small holes in the cloth at selvages when passing through the temple. The teeth in the temple roll engaging in the cloth to keep it the required width will cut the filling where selvage is pulled in. This is especially noticeable on fine goods.

CUTTING FILLING.

Groove in Shuttle Not Deep Enough.—When the shuttle is in shuttle box the filling lies in the groove of the shuttle. If the face of the shuttle has been worn by constant wear and the groove is not deep enough the filling is likely to be cut. The groove on the end of shuttle beyond the eyelet must not be allowed to wear off, as this is a source of cutting filling especially on fine work.

Eyelet in Shuttle Sharp.—This is caused by face of shuttle being worn and with shuttle striking the mouthpiece of the box as it is entering box.

Shuttle Rising in Box.—When using an iron swell, the swell can be bent over a trifle, so that the shuttle will come in contact with top of the swell first, and this will prevent shuttle from rising.

Temple Too Low.—If the trough of the temple is too low, the filling which often gets under the temple will be cut by temple rubbing against race-plate.

Shuttle Spindle Sharp.—When using cop filling it is sometimes necessary to open out the spindle to prevent the filling from breaking. In doing this the end of the spindle becomes sharp, and when the cop is put on spindle the filling is cut inside the cop.

FILLING BREAKING.

Pick Too Strong.—If the pick is too strong, the shuttle will strike too hard in the box and filling will be broken.

Boxes Too Loose.—If the boxes are too loose the shuttle will not be checked and will strike hard against the picker and filling will be broken.

Shuttle Spindle Too Small for Cop.—If the shuttle spindle is very much too small for cop it will have to be replaced with a new one. A spindle can often be made large enough to hold a cop by opening it, but care is required so that the spindle will not cut the filling.

CHAPTER IV.

GINGHAM LOOMS.

When fabrics have to be produced in which there are various colored threads in the filling, drop-box looms have to be used. These looms are usually constructed with either two, four or six shuttle boxes at one end of the lay and one shuttle box at the other end. They are also made with either two or four boxes at each end of the lay. When built in the former manner an even number of picks of any given color of filling must be inserted in the cloth, as the shuttle must return to the drop-box end before a change can be made from one color to another. There are a number of different motions in use to operate the drop boxes, one of the best of these being known as the sliding tooth box motion.

BOX MOTION.

This motion is illustrated in Figs. 4, 5 and 6.

These figures show two views of the motion; first when looking at the motion from the end of the loom, and the second when looking at the motion from the back of the loom. In Fig. 6 the shape of the eccentric C and the crank E is illustrated. In Fig. 4 A represents the driving pin in the pin-wheel, said pin-wheel being set screwed on the pick-cam shaft. B is the star gear. C, the single-box eccentric. D, the side lever. E, crank for two-box movement. F, the small segment gear. G, the double-sliding tooth. H, rod through which the top double-sliding tooth is operated. J, rod through which the bottom sliding tooth is operated.

Operation of Motion and Boxes.—As the pin-wheel, which is set-screwed on pick-cam shaft, is carried around with the

shaft, the driving pin A passes into one of the recesses of the star gear and carries the gear forward. The periphery of this gear is divided into ten parts of seven teeth, and an empty space equal to three teeth.

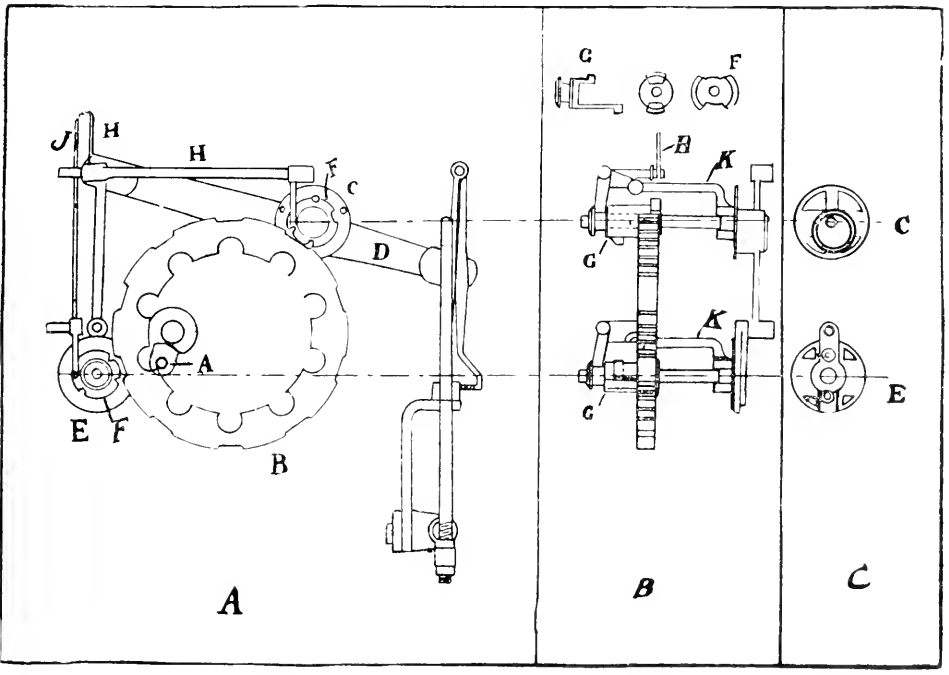

Fig. 4. Fig. 5. Fig. 6.

Another make of star gear has ten parts of eight teeth and an empty space equal to two teeth. The small segment gears F have six teeth on each side with an empty space between the teeth. The empty space on the star wheel and small segment gears are always directly opposite to each other. This is to allow the double-sliding tooth to pass in and out when the boxes have to be changed. On the same shaft with one of the small segment gears is an eccentric and on the shaft

with the other small segment gear is a crank. The eccentric and crank is to operate the boxes by raising or lowering them. The single-box eccentric C is illustrated in Fig. 6, and also the crank E. The side-lever D fits directly onto the eccentric. The drawings illustrate the motion when the boxes are in their normal position, viz, with first or top box opposite the race plate. When the eccentric and crank are in this position the projection on end of double sliding tooth is on the outside, so that when the loom is running the star gear will revolve without coming in contact with the projection and boxes will not be changed.

Timing of Box Motion.—The boxes are timed by the pin wheel on end of pick cam shaft. This can be set to turn the star gear at any point. One setting is to have the driving pin in contact with the star gear when lay is eight and one-half inches from the breast beam with the lay coming forward. Another good setting, and one which will generally give satisfaction, is to set the driving pin in pin wheel to turn the star gear so as to have the boxes about one-eighth of an inch above or below the race plate when the dagger is in contact with the receiver. The receiver must be in the same position it will be in when loom is running. By the term, above the race plate is meant, when boxes are being raised; below the race plate, when boxes are being lowered.

To Raise from First to Second Box.—Insert a riser in the box chain under the lever which operates (through the rod H), the double-sliding tooth on the eccentric. This will force the short end of the double-sliding tooth between the star gear and the small segment gear and the projection on the end of the tooth will fill in the space between the two gears. When the driving pin in the pin-wheel turns the star gear, the first tooth in the gear will come in contact with the

sliding tooth. This enables the teeth in both segment gears to be meshed into each other and the eccentric is turned half around. The deepest portion of the eccentric is turned from bottom to top, which raises the side lever D and consequently the boxes. This brings the second box opposite the race plate. The long end of the double-sliding tooth is now between the segment gears with the projection on end of tooth beyond the gears—this allows the star gear to revolve without coming in contact with the small segment gear. The finger will remain in this position until the boxes have to be changed.

To Return Box to Original Position.—On the next bar in box chain leave off the riser. This will force outwards the double-sliding tooth and the projection on the end of tooth will fill the space between the two gears. When the driving pin in pin-wheel turns the star gear, the first tooth of the gear will come in contact with the projection, and the eccentric will be turned to its original position, which will bring the first box opposite the race plate.

To Raise From First to Third Box.—Insert a riser under the lever which operates (through the rod J), the double-sliding tooth on the crank which controls the two-box movement. This will bring the projection on the small end of double-sliding tooth between the two segment gears, and the crank will be turned half around exactly as in the case of the eccentric above described.

To Bring Boxes Back to Original Position.—On next bar of box chain, leave off the riser. This will bring the projection on tooth between the two segment gears, and the crank will make half a rotation to its original position with the first box opposite the race plate.

To Raise From First to Fourth Box.—Insert a riser in box chain under both levers. This will bring the projection

on the short end of both double-sliding teeth between the two segment gears. When the driving pin in pin-wheel turns the star gear both the eccentric and the crank are turned half around and the fourth box is brought opposite the race plate.

To Bring Boxes Back to Original Position.—On next bar leave off both risers. This brings the projection on long end of both double-sliding teeth between the segment gears and both the eccentric and the crank will be turned half around, which will bring the boxes back to original position, the first or top box opposite the race plate.

When making a fabric, the boxes do not change in the order given, that is to say, they do not return to normal position each time before a change to another box is made. The order as given above shows the principle of raising and lowering the boxes separately. In actual practice the changes are made according to the colors in the shuttles and the colors required in the fabric.

The changes thus far indicated are as follows: First to second box, riser under single-box lever. Second box to first box, empty bar. First box to third box, riser under lever that operates the crank for the two-box movement. Third box to first box, empty bar. First box to fourth box, riser under both levers. Fourth box to first box, empty bar.

Any change between these can be made. If two risers will raise from first to fourth box, then to lower to third box, the riser on the single-box lever is left out. To lower from fourth to second box, the riser under lever that operates the crank for two-box movement is left out.

CHAPTER V.

GINGHAM LOOM BOX CHAIN BUILDING.

In building box chains there are several points that have to be taken into consideration. First, there should not be a skip from first to fourth box, or from fourth to first box, if it is possible to avoid it, as this subjects the motion to a great strain, for the boxes must be changed in the same time as when making a smaller lift. Second, when using a soft-twisted filling in one shuttle, that shuttle should be put in top box when possible, as this will prevent the soft-twisted filling from clinging to the other filling. It is also often advisable to put the dark filling in top box when possible.

Arranging the Colors in Boxes.—Example: A gingham fabric is required to be made from the following colors: 6 picks white, 4 picks black, 6 picks white, 4 picks red, 6 picks white, 2 picks green. One of the best methods for obtaining the arrangement of colors in boxes is as follows: Write under each other the different colors as they occur in the fabric, then opposite each color mark the number of box in which the color is to be tried in; the top box being the first box. Using example given, Fig. 7 illustrates the colors as they occur in example, also beginning in first line with the first color in first box. This does not give a good arrangement, as there is a skip from first to fourth box, also from fourth to first box. The number of picks of each color to be inserted in the fabric is indicated at the side. The second or third arrangement will be satisfactory, as there is only a skip of one box. The box chain for this example is given at Fig. 8, using the second arrangement of colors. S indicates single lever to raise one box. C indicates crank to raise two boxes. X rep-

resents riser, empty squares represent sinkers. Each bar in box chain equals two picks.

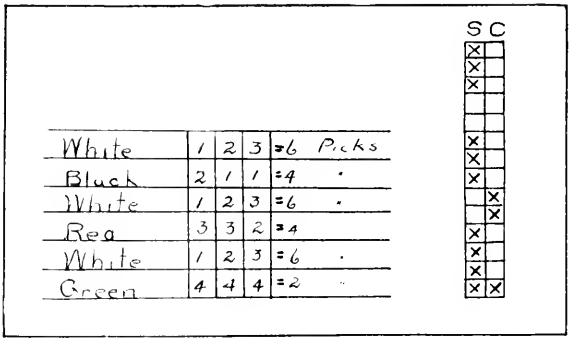

Fig. 7 and 8.

MULTIPLIER.

When check patterns are to be woven in which a large number of picks of the same color are inserted in the fabric before a change is made to another color, the multiplier is of great value, as considerable time is saved in building box chains, the length of the chain being greatly reduced. The Crompton and Knowles box-motion multiplier, in its simplest form, consists of a disc which has on its periphery two depressions. A ratchet gear is fastened to the disc, said gear having twelve teeth, each tooth representing two picks. With two depressions in the disc this will represent a twelve-pick multiplier. A small finger presses against the periphery of the disc, said finger being connected to a lever, which is under a pin in the driving pawl of the box-chain barrel. When the finger is in one of the depressions in the disc, the multiplier is stopped and the chain barrel is working, viz, the chain-barrel pawl is turning over the chain barrel one bar every two picks. To start the multiplier, a riser is put in the box chain under the multiplier lever. This causes a

lever to be lowered and a pawl comes in contact with the ratchet gear on disc, and the disc is turned. The finger is forced out of the depression on the disc, which also raises the chain-barrel driving pawl out of connection and prevents further movement of the box-chain cylinder. The disc will continue to turn until the finger drops into the next depression, and this will start up the box chain. From one depression on the disc to the other represents twelve picks of the same color that will be put in the cloth before a change is made, so that if twenty-four picks of the same color are required in the cloth a multiplier riser will have to be put on two adjoining bars of the box chain.

Example: A gingham fabric is required to be made with the following colors, using a 12-pick multiplier; 6 picks black, 12 picks green, 6 picks black, 24 picks red, 4 picks white, 24 picks red. Fig. 9 illustrates the different arrangement of colors in boxes. The second and third lines give the best arrangement, as there are no skips whatever in these.

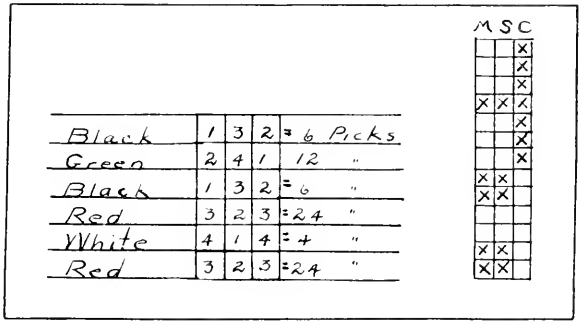

Fig. 9 and 10.

The box chain is illustrated at Fig. 10, using the second line. X represents riser, empty squares represent sinkers. S indicates single lever. C indicates compound lever. M indicates multiplier lever.

STILL BOX MOTION.

This motion is indispensable to the box loom. Its purpose is to prevent broken patterns, that is, if the filling breaks, the chain barrel is not pushed forward and the loom can therefore be started up without making a mis-pattern. One

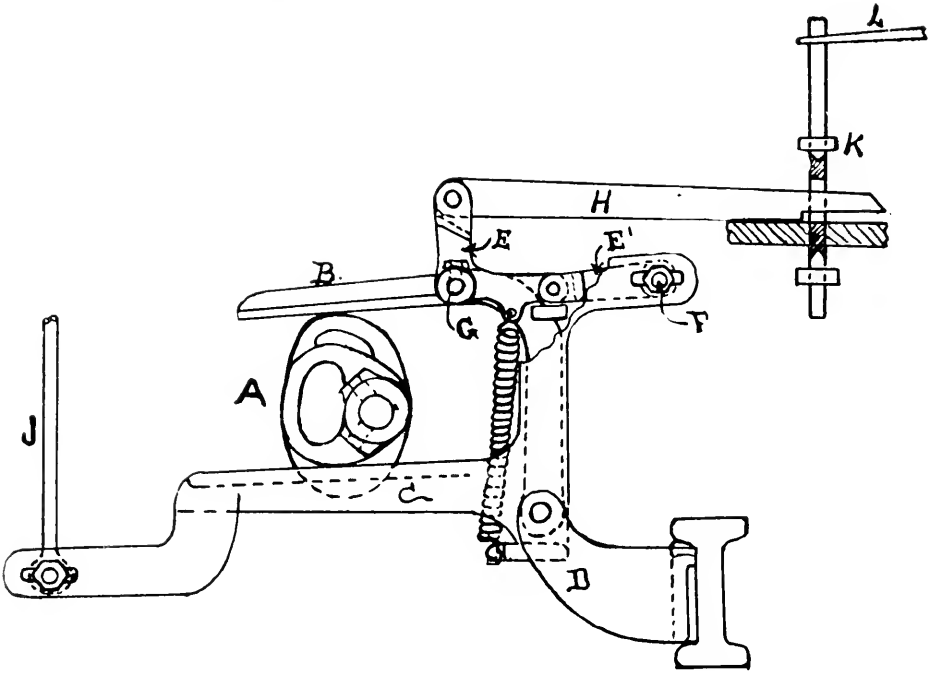

Fig. 11.

of these motions is illustrated at Fig. 11. A double cam A is fixed on the pick cam shaft. This cam revolves between the two levers B and C, which are pivoted at D. A locking lever E is mounted on a stud on the upper lever at G, said lever E locking with arm E^1, mounted on stud F fast in lower

lever C. A catch slide H is attached to the top end of the locking lever. The cylinder connector J is attached to the lower end of the cylinder lever C. The catch slide works forward and backward through a slotted sliding bar K, which is supported by a bracket to the side of the loom. The slotted bar is illustrated in Fig. 12.

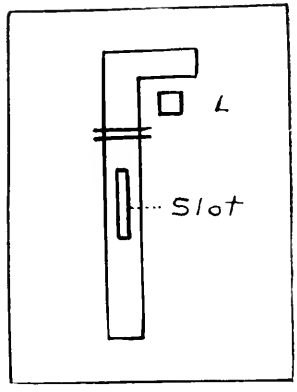

Fig. 12.

Operation of Motion.—A rod extends the full width of the breast beam. On one end of the rod a finger is attached, which is in contact with the filling fork slide, and on the other end of the rod the finger L is attached. When the loom is running, the cam A revolves with the shaft, the larger of the two cam surfaces operating under the top lever B. The two levers, B and C, are held together through the combined action of a spring and locking lever, so that when the top lever is raised the bottom lever is also raised. The cylinder connector J is therefore raised, which forces over the chain barrel and at the same time gives a forward movement to the catch slide H, which passes through the slot in sliding bar. The small cam will draw back the levers. When the filling breaks, the filling fork slide forces back the finger

which is in contact with it, and this raises the finger L, at the same time raising the slotted sliding bar K. As the catch slide comes in contact with the bottom of the slot the forward movement is stopped. This forces back the locking lever E and causes the latter to turn on its pivotal support G, against the action of the spring, allowing the arm B to be raised by the movement of the cam while the arm C remains stationary, and the action of connector J on the chain barrel is immediately arrested.

Timing of Still Box Motion.—With lay on front center and shuttle in single box end, the cam should begin to move forward the catch slide H.

BREAKAGE PREVENTORS.

The breakage preventor in the box motion consists of a spring bolt, which holds the top of the sliding tooth shaft box in position. This is a spring on an ordinary bolt and is of sufficient strength to keep the top of box in position when everything is in good working order. The empty spaces of the star gear and small segment gears should be directly opposite each other, so that the large gear can revolve without coming in contact with the small gear; but if from any cause the small gear should be turned over so that the large gear connects when it ought not to, the top of the sliding tooth shaft box will be forced up, and this will prevent the teeth in the gears and also the top of the sliding tooth shaft box from being broken.

The small gear turning over farther than it ought to is often caused by a weak spring on the spring lever. On the back of each cam are four projecting pins and a lever is held on two of the pins, which, if of sufficient strength, will prevent the cam from moving out of position after being changed,

but if the spring is weak the small gear will partly turn over and be caught by star gear. Spring lever is shown at K, Fig. 5.

Another breakage preventor is in the form of a spring clamp. The stud in the end of lifting rod D, Fig. 4, by which the boxes are raised and lowered, is held by a spring clamp. Fig. 13 illustrates an end view of the boxes and the

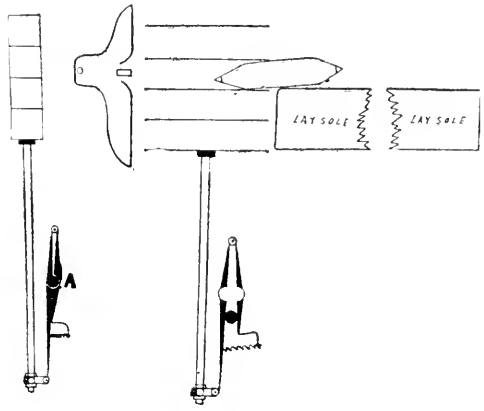

Fig. 13 and 14.

spring clamp with the stud in clamp marked A. If the shuttle should be trapped between the lay sole and boxes as boxes are being raised or lowered, the stud will be forced out of its position and no damage will be done to either shuttle or shuttle boxes. Fig. 14 illustrates the shuttle trapped between shuttle box and lay sole as box is being lowered. It will readily be seen that unless the stud was forced out of position either the shuttle or shuttle box would be broken. If the picker or anything else should get stuck in the boxes the same thing will occur.

SHUTTLE CHECK CAM.

On some box looms a shuttle check cam is used. This is a small cam about two and one-half inches or three inches in length and extends about one-half inch beyond the surface of the pick cam on the drop box side of the loom. When the crank is on back center the pick cone should be in center of cam and the lug straps set to hold the picker stick not more than one inch on the spindle.

CHAPTER VI.

GINGHAM LOOM FIXING POINTS.

Shuttles.—All shuttles must be as near the same size and weight as it is possible to get them or good results cannot be obtained. The single box has to be fitted to all the shuttles, because if one shuttle is very much different from the others there will be trouble in running the same. The shuttles should not be too large or they will chip through striking the mouthpiece of the box.

Swells.—The swells should be bent to grip the shuttle about half-way, also to give a gradual check to the shuttle as it enters the box. The flat end of the swell should not be set full against the box, as there is always more or less loose filling when the shuttle is leaving the box, and if the end is full against the box there is a tendency to cut the filling. It is only necessary to have the extreme end of the swell against the box.

Sharp Edges in Boxes.—In starting up a new set of boxes it is advisable to take off all sharp edges with a very fine file. The groove in swell must be perfectly smooth, as any sharp edges will cut the filling. The sharp edges of picker race should be taken off or shuttle will be cut.

Shuttles Working Loose in Box.—When large patterns are made in which a shuttle is used only occasionally, there is a tendency for this shuttle to work forward in the box with the result that when the shuttle is picked across the lay the loom will bang off. To overcome this the swell should grip the shuttle half-way, and shuttle should be held firmly in box, but not too tight. The boxes should work freely in the slides, but should not be loose or they will swing about, and

this has a tendency to cause the shuttle to gradually move to the front end of box. The picking motion must also be set to give an easy pick.

Putting on New Picker.—When a new picker is put on it must be perfectly true. If warped in any way good results cannot be obtained from it. The picker must work freely on the spindle and in the picker race. A small hole is often made in the picker where the shuttle strikes. A good bunter should always be kept on the spindle, as this saves the picker and the stud from the jar that would otherwise be given when the picker strikes the spindle stud. Bunters are made in different ways, but a serviceable one is made from a strip of leather with spindle holes cut in it about two and one-half or three inches apart. A leather washer can also be put on the spindle between the holes.

Guide Plate.—When the picker is at the back end of the box the face of the picker should be flush with the guide plate. If the face of picker is not flush, but is too far back in the box, the shuttles will also be too far back, and when the boxes are changing, the tips of the shuttles will strike the guide plate and will soon become flat on the end, which will cut the yarn as the shuttle is passing through the shed. A buffer is used on the back end of spindle and also in the back end of box, and by regulating this the face of the picker can be made flush with the guide plate. These buffers also reduce the jar when the shuttle strikes the picker. The buffer in the back end of box can be made from cloth in the form of a roll, or can be made of leather.

Setting the Boxes.—The boxes must be set so that the bottom of each box will be level with the race plate. If this is not done there will be considerable trouble with the shuttles chipping and also flying out.

The first or top box is adjusted by the set nuts at the bottom of lifting rod. The second box is adjusted by the stud in slot at front end of lifting lever. The third and fourth boxes are adjusted by the stud in slot at back end of lifting lever, also by crank E.

No positive rule can be given to set the boxes. Each box has to be set separately, beginning with the top box. If, in changing from one box to another, the boxes do not come level with the race plate after setting the first box, the leverage is not equally divided. By moving the studs in slots of lifting lever backward and forward, according to whether the boxes are too high or too low, the right leverage will be obtained. Any change in either of the studs will correspondingly change the position of the boxes.

To illustrate the difference in leverage when raising the boxes refer to Figs. 4, 5 and 6. When a change is made from first to second box the single box cam C is turned. This brings the largest part of the cam on top with the fulcrum of lifting lever at the back end of lever. To change from first to third box the crank E is turned. This brings the fulcrum of the lifting lever on the single box cam with the cam in its normal position, that is the largest part of cam at bottom. To change from first to fourth box both cams have to be turned. This will change the position of the fulcrum on the lifting lever. From this it will be seen that as the position of the fulcrum changes there can be no hard and fast rules given to set the boxes, but judgment must be used in setting them. The boxes must either be perfectly level, or the back end elevated a trifle with the front end level with the race plate. Under no circumstances must the back end of the box be lower than the front end.

Boxes Skipping.—If the links on chain are not set right the chain will have a tendency to bind. The links should be

put on the bars so as to have them alternate; that is, one outside and the next inside, on both sides of the chain to correspond. Short or bent links will cause the chain to ride on the barrel, instead of dropping in the notches. Double-sliding finger not working freely will cause the boxes to skip. It is necessary that this finger be kept well oiled, in fact, the whole motion must be kept well lubricated.

CHAPTER VII.

DOBBY HEAD MOTION.

Two kinds of dobbies used in cotton mills are known as single action dobby and double action dobby. The single action has a closed shed, but the double action has an open shed. In a single action, the harness returns to the bottom of the shed every pick. These machines are not used very extensively, but where they are used, fancy lenos are generally made on them. This dobby has several disadvantages, the principal one is that the loom cannot run very fast because of the time required to change the harness from one pick to another. Another disadvantage is that the filling has to be beaten up into the cloth in a closed shed. The dobby that is most extensively used at the present time is the double action dobby. This dobby is often referred to as double index or single index dobby. The working parts of both are practically the same, the actual difference between them will be explained under separate headings.

DOUBLE INDEX DOBBY.

A sketch of the working parts of a double index dobby is given at Fig. 15. The following are the names given to the different parts: A, harness lever. B, B^1 are the jack hooks. C, jack. D, connection of jack with harness lever. F, rod which passes through all the harness levers. G, rod on which the ends of all the harness levers work. H, $H,^1$ knives. J, J^1, index fingers. K, rod which passes through all the index fingers. L, chain barrel. The harness lever A has a number of notches on the top. These notches are for the purpose of regulating the lift on the harness shafts. Each harness

shaft is connected to a harness lever by a wire loop and harness strap. The loop is put in one of the notches. For front harness shafts the loops are put in notches near the bottom and are stepped higher in the notches for back harness. The reason for this being that the back harness shafts have to travel a greater distance than the front harness shafts in

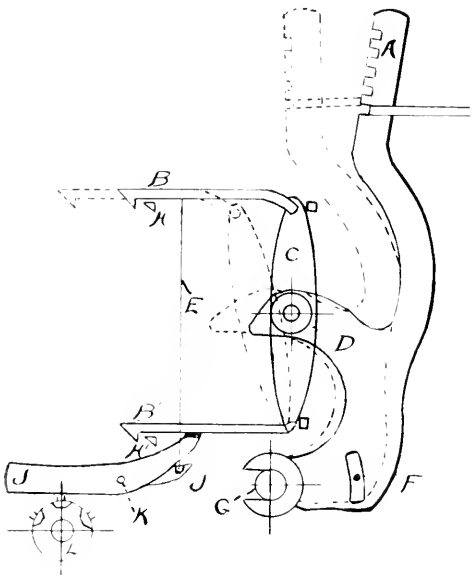

Fig. 15.

order to make the same size of shed. Rod F, which passes through all the harness levers, is fixed outside the frame of dobby. Its purpose is to keep the harness levers in contact with the rod G, and also to prevent the bottom of the levers from jumping out when levers are being raised. The index finger J is in contact with the top jack B through the needle E, but the finger J^1 is directly in contact with the bottom jack hook B^1.

SINGLE INDEX DOBBY.

A sketch of the working parts of a single index dobby is given at Fig. 16. In comparing this sketch with Fig. 15 it will be seen that the only difference between them is in the method of operating the jack hooks through the index fingers.

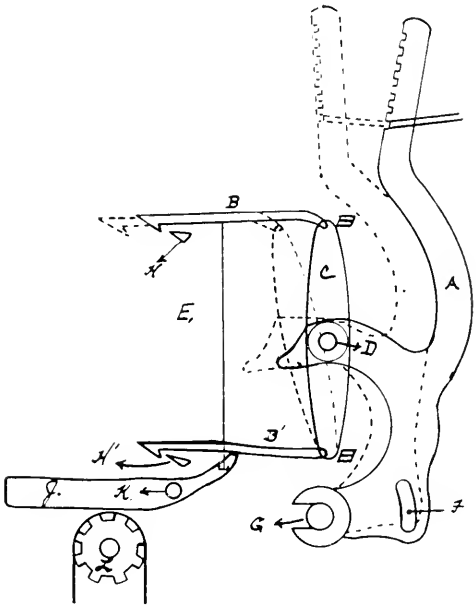

Fig. 16.

In this dobby one index finger operates two jack hooks, the bottom jack hook by being directly in contact with the finger and the top jack hook in contact through the needle E. The top of the needle is directly under top jack hook and the bottom of the needle fits into a small groove at the end of the index finger, so that when the finger is raised both hooks are lowered at the same time, and one of them will be caught on the knife that is moving outward on that pick. Stated briefly,

the distinctive difference between the two dobbies is as follows: In a single index dobby, one index finger operates both top and bottom jack hooks. The chain bar is turned over every pick, as each bar only represents one pick. In a double index dobby, one index finger is required for every jack hook. The chain bar is turned over once on every two picks as each bar represents two picks. There are twice as many index fingers in a double index dobby as there are in a single index dobby.

OPERATING DOUBLE INDEX DOBBY.

In operating the dobby, the knives H, H' are connected at each end by a knife hook to a rocking arm. The knife hooks are threaded on the end so that the knives can be set in different positions. Fig. 17 shows the knives connected to the rocking arm by the knife hooks. The rocking arms are fulcrumed in the center, and as one knife is coming forward the other is returning. To raise the harness shaft a peg is put in a bar in the chain. The chain is put on the chain barrel L, and the peg comes in contact with an index finger. If a peg is put under the index finger J the opposite end of the finger is lowered, because the rod K acts as a fulcrum for the fingers. This lowers the jack hook so that when the knife comes forward, the catch on the hook is caught on the knife and the harness lever and harness shaft is raised. This is clearly seen in Fig. 15. A peg is placed in the chain bar under the index finger J, which lowers the top jack hook over the knife H. As the knife comes forward, it catches the hook and pulls the jack and harness lever to position indicated by dotted lines. In many dobbies the rocking arms are of different sizes. The front rocking arm is smaller than the one at the back. This is to allow greater leverage on the back harness.

Driving Dobby.—The dobby can be driven either from the crank shaft or pick cam shaft. When driven from pick cam shaft a driving rod is connected from rocking arm in dobby to a crank setscrewed on end of bottom shaft. On this drive a pawl is always used to turn over the chain barrel. When the dobby is driven from crank shaft the rocking arm is connected by a driving rod to a gear, which receives motion from gear on crank shaft of half the number of teeth, so that two revolutions of gear on crank shaft are required to make the inward and outward movement of knives in dobby.

Driving Chain Barrel.—There are two distinct methods of driving chain barrel: First, by pawl fixed on front rocking arm. Second, by worm and worm gear. In the first method a ratchet gear is setcrewed on the front end of chain barrel shaft. This gear is pulled over by the pawl fixed to a stud in the lower portion of front rocking arm. The pawl pulls over the chain barrel when the lower portion of rocking arm is on its inward movement, so that when this driver is used each bar in chain represents two picks. The distance chain barrel is turned, can be regulated by raising or lowering pawl stud in slot of rocking arm. When stud is raised leverage is decreased, but when lowered, leverage is increased. When a change is made in either case a corresponding change has often to be made with the ratchet gear.

The second method of driving is used on both single and double index dobbies, generally on single index. In this method motion is imparted to the chain barrel from the crank shaft. One arrangement is as follows: A gear of 30 teeth on crank shaft meshes in another gear of 60 teeth. This latter gear is setscrewed to an horizontal shaft that carries a small bevel gear on the opposite end, which meshes into another bevel gear fixed on a vertical shaft. At the top of the vertical shaft a worm is attached which drives the worm

gear on chain barrel shaft. This drive is for a single index dobby and a double worm is used. In setting any of these motions, care is required so as to obtain the correct timing.

Setting Dobby on Loom.—To set a dobby on a loom there are a few points that will require to be taken notice of. Adjust the position of the cord rollers or sheaves so that the harness shafts will be suspended an equal distance from each side of the loom. Have the front cord roller adjusted so that the front harness will be from one-half to three-quarters of an inch behind lay cap when crank is on back center. Set the spring blocks on the floor in a line with the roller cords. This can be obtained by dropping a plumb from the rollers at the sides on which the cords work. The point thus found will be the center of spring block. Harness hooks can be put in harness shafts to correspond with plumb line.

Starting Up Dobbies.—When starting up a new dobby the harness levers will have to be adjusted so that they will work free and easy. The levers can be adjusted by set-nuts on each side of the frame. Dobby is generally run before connecting up the harness straps, and in running, the levers should drop of their own weight. Every working part will require a good oiling. In a double index dobby with a worm gear drive for chain barrel, connection between driving of dobby and chain barrel will have to be specially noticed, so that both can be set together on the same pick. To illustrate: The dobby can bet set so as to have either the top or bottom knife coming outward on the first pick. If the first row of pegs in the chain govern the top set of jack hooks, the driver will have to be set so that the top knife will come out on first pick. If driving is set so as to have bottom knife coming outward on first pick, a broken up pattern will result, because the second row of pegs, which is the second pick, gov-

erns the bottom jack hooks, and this will cause the harness that ought to be raised for second pick to be raised for first pick. The picks will be put in the pattern as follows: Second, first, fourth, third, sixth, fifth, and so on, which gives a ragged appearance to the pattern.

Obtaining the Size of Shed.—The size of shed required on a dobby is just sufficient to allow the shuttle to pass through without chafing the yarn. The shed can be regulated generally in three different places: First, driving crank. Second, rocking arm. Third, knife hooks. On some dobbies the size of shed can only be regulated at the driving crank and knife hook. In both cases the required adjustment can generally be made. First have the harness shafts strung up to harness straps, with the springs attached underneath. Keep the yarn tight when tied to the apron and have the yarn just resting on the race plate. The reason for having the yarn just resting on the race plate is that when filling is beaten into the cloth the bottom shed is raised up a trifle. Have the harness shafts level at both ends with the back harness shafts a little lower than the front. This is sometimes called an angular shed and is obtained by the harness levers coming in farther at the back, in other cases by increasing the length of the harness straps. Set the lower stud of connecting arm about half way in the slot of the driving crank and the top stud of connecting arm also about half way in the slot. The rocking arm should be vertical when the driving crank is on front or back center and the loom crank shaft past bottom center. When the driving crank is on top center, set the bottom knife about one-fourth of an inch behind the catch on jack hooks. When the driving crank is on bottom center set the top knife the same distance behind the catch on jack hook. This adjustment is made by set nuts on the knife hooks. If this setting does not give the correct size of shed the sweep

will have to be adjusted at either the driving crank or rocking arm. The object of setting the stud about half way in the slot is because that position gives a medium sweep of knives. If the shed is found to be too small the connecting stud will be brought to the outer end of slot in driving crank. This will give a larger sweep, therefore a larger shed, but in consequence of this larger sweep, when the driving crank is on top and bottom centers the knives will be too far behind the catch on jack hooks. It is also possible that this change of sweep may pull the knives too far back, so that they will strike the back end of the knife slide. In either case the knives will have to be re-adjusted by the set nuts on knife hooks. If the shed is too large and a smaller shed is made it is possible that the knives may not get back of the catches on

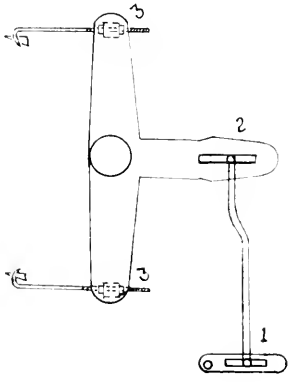

Fig. 17.

jack hooks, and will have to be re-adjusted in just the opposite way to the former.

Fig. 17 illustrates clearly the three positions where adjustment in size of shed can be made, indicated by figures 1, 2, 3.

Pattern Chain Pegging.—In pegging chains, two items

have to be taken into consideration: First, is loom right or left-hand. Second, in what direction does chain barrel revolve. It is necessary that these two items be known, especially the first, for the following reason: If loom is right-hand, the dobby will be on left-hand side; but if loom is left-hand, dobby will be on right-hand side. If a chain has been pegged for dobby on right-hand loom it will not work on a dobby on left-hand loom unless turned round and last bar used for first. On some patterns this does not make much difference, but on others it does. It is advisable to have one system and adhere to it, viz: always begin with first harness on one side for all chain plans made. If this is done the chain can be made from chain plan with simple instructions.

To illustrate: Have first harness shaft on right-hand side; also have first pick in chain plan on top. On a right-hand loom, chain will be pegged from right to left, reading from first harness. On a left-hand loom, chain will be pegged from left to right, reading from first harness. If this system is used it is only necessary to state whether loom is right or left-hand. These instructions are for chain barrel revolving inward towards the loom. For an outward revolving chain barrel, it will be necessary to state this in giving instructions, as R. H. out, and chain will be pegged opposite to inward revolving chain barrel.

Requirements of a Good Dobby.—The dobby that is the simplest in its construction where the different parts can be taken out easily to be repaired will be the best to use, everything else being equal. All the different parts of the dobby should be made in their right proportion. The index fingers, hooks, needles, should all work free with each other. Especial notice should be taken of the index fingers. See that these fingers are cast straight and smooth, otherwise they will rub against each other and miss-picks will result. This oc-

curs occasionally in a double index dobby. When this is the case the fingers will have to be taken out and finished off on the emery wheel to take all the rough places off them. A dobby that will require all this work doing to it when new is certainly not the dobby to select. Another requirement is that the dobby be of the right capacity with the loom, that is, if the loom is only adapted for a twelve harness dobby, it certainly is not wise to put on the loom a twenty or twenty-four harness dobby. If this is done, every time the lay goes back it will strike the harness shafts and cause them to vibrate. This will result in poor weaving, the harness shafts will be continually catching on each other and making miss-picks and smashes, also if the harness straps are not securely fastened to the hooks, the shafts will be continually dropping and making smashes. To use a dobby of a capacity of twenty to twenty-four harness shafts there should be at least ten inches between lay and crank shaft when lay is on back center. This is allowing the harness shafts to be about three-eighths of an inch thick.

PREPARATION OF HARNESS SHAFTS.

In preparing harness shafts there are several small details, which if properly attended to will help very materially the production and quality of cloth. These details can be enumerated as follows:

Do not allow the heddles to get rusty. Rub heddle rods evenly with tallow or oil, or a mixture of tallow and oil. This allows the heddles to slide free on the rods. Put all heddles on shaft the same, that is do not put on some heddles with twisted ends on top and other heddles on same shaft with twisted ends at bottom. Have the twisted ends of the heddles on all shafts the same, that is, have all on top or all on bottom. Have only one counts of heddles on a shaft, do

not mix fine and coarse heddles together. Heddles must work free on heddle rods. The hooks that support the heddle rod must not be too deep in the shaft or the rods will hold the heddles tight and they will not move freely. Have all hooks for heddle rods facing the front. Have heddle rods secured on both ends of the harness shaft. This must be specially noticed, as a smash often results through heddle rods slipping out. Have harness hooks on top of harness shafts set in line. Have harness hooks set so that there will be a straight and an even pull on the springs.

DRAWING IN THE WARP.

Have the harness shafts suspended in front of drawing in frame with heaviest weaving harness in front. This is the general method of arranging the harness. For example, if a plain and fancy stripe is being made the plain harness shafts will be on front. If single beam, have slasher comb or lease level with heddle eyes. If two or more beams, always put yarn from bottom beam over top of drawing in frame first, then yarn from the other beams to follow. Have a rod between the threads from each beam to keep them separated. There are two methods of arranging the combs. First. Have the combs on the top of each other. The comb for bottom beam will be on top with the other combs underneath. This brings the yarns from top beam in front of the yarn from bottom beam. This method does not take up much space. Second. Have all the combs level. The back comb will be from bottom beam with the other combs in front. Put up harness shafts in right order, then have warp drawn in. On many patterns the harness shafts can be divided into sections to have the warp drawn in. Take, for example, fancy stripe to be made on plain ground. Harness shafts for plain will be in front, harness shafts for fancy stripe will be

at back. To divide in sections, leave off the plain harness shafts and draw in fancy stripe, keeping each stripe separate. Put up the harness shafts for plain and draw in the plain threads. When the required number of threads have been drawn in on plain harness shafts for one pattern, pull the threads for one fancy stripe through plain harness shafts. Repeat this until all the warp is drawn in. It must be understood that this cannot be done on all patterns, only on those patterns in which the threads from each beam forms a stripe with all threads together.

When warps are to be drawn in without a hander in, the drawing in hand begins on right-hand side; with a hander in, on left-hand side. When all threads are drawn through heddles, draw the warp in reed. If reed is too wide, divide the space equally on both ends.

STARTING UP THE WARP.

Have the loops on harness levers in dobby stepped, that is, the front loops in lowest notches; raising the other loops in notches in the same proportion. Bring the beams from the drawing in frame on beam truck provided for that purpose. Support the harness shafts between crank shaft and lay on two rods, then put beams in loom. Hang the harness on harness straps. Attach the springs to bottom of harness shafts carefully. This is very important, especially when using fine yarns. It is also necessary to have the same strength of spring on each side of the shaft. One method of testing springs is as follows: Have a straight piece of wood about one yard in length with a screw in one end and at the other end lines ruled about half an inch apart with the lines numbered. Take each spring separately, put one end on screw and suspend a weight on opposite end. This will pull out the spring a certain distance, which will be indicated by the

lines. Lay together all springs of the same strength, take springs to loom and connect the strongest springs to the heaviest harness shaft; that is, the harness shaft that has on it the most heddles and has the heaviest lift. Have whip roll level with harness eyes so that there will be an equal strain on the yarn when shed is open. Fix reed in lay sole and tighten up the lay cap. Put friction rope around beam heads to prevent from turning. Set the harness shafts so that the back shafts will be a little lower than the front. Both ends of the shafts should be level. Have the yarn just resting on the race plate. When weaving the yarn will be raised from off the race plate somewhat. Tie in the threads carefully to an apron. On fine yarns do not tie in too many ends at one time, as it is necessary to have every thread drawn tight before tieing to apron, otherwise threads will be broken out.

Divide the heddles equally in sections made by heddle rod hooks. If the heddles are not divided equally more will be left on one side than the other, and as a result the heddles are pulled out of their true position at the heddle rod hooks, which will cause the heddles to be crowded at this point so that when the harness shafts are being raised and lowered the threads are chafed. Put in the lease rods. For large rod, raise back harness shaft and every alternate harness shaft. For small rod raise the opposite harness shafts. Set temples the required width. See that they do not come in contact with race plate or touch the reed. Put pattern chain in dobby and turn over lay. Open out the shed and throw shuttle through three or four times in same shed, then turn lay over and repeat this several times before starting up loom by power. Put on right pick gear. Occasionally a pattern chain is made to weave plain on all the harness shafts so as to get in the loose threads if there are any and to obtain a better starting up of the warp.

CHAPTER VIII.

DOBBY FIXING POINTS.

The greatest fault that can be found with dobby cloths is miss-picks, and many pieces are rejected and put in seconds on account of them. This is especially true when old dobbies are used. There are various causes for miss-picks, which can by a little care be remedied before much damage is done. A number of these causes will be mentioned and a remedy for same, or a short explanation as to how the miss-pick is caused and the remedy can be applied.

Pegs in Chain Bar Not Set Straight.—The pegs should be put in the chain bar perfectly straight, if not, the pegs that are not straight will get in between the index fingers. The index finger that ought to be raised will not be and a miss-pick results. Under each index finger there is a small groove, and if the peg is straight in the bar it will work in the groove. The chain should be put on the barrel and every bar examined before the loom is started up.

Wrong Setting of Chain Barrel.—The chain barrel should not be set too high nor too low. If set too high the index fingers will jump and this will have a tendency for them to catch on the knife when knife is coming out. If the chain barrel is set too low the hooks will not be lowered enough to get fully on the knife and as the knife moves out the hooks will often slip off. Especially will this be the case if the knife is worn. In some dobbies the knife can be turned when worn on one side. In other dobbies the knife will have to be ground down straight all the way across and then re-set to take up the amount ground off. When a harness shaft drops in this manner the threads on that shaft are often broken out. This also causes the shuttle to fly out occasionally.

Chain Barrel on Wrong Time.—The chain barrel must be set on correct time. A good general setting is to have the pegs in the chain bar directly under the index fingers with the knife about one-quarter of an inch from the catch on jack hook with knife making its outward movement. If the chain barrel is being turned by a pawl from the rocking arm, see that the check on the shaft of the chain barrel holds the barrel steady after being turned, also, that the pegs are directly under the index fingers with fingers at the highest point. This means that if the fingers are at the highest point, the jack hooks will be at the lowest, or in other words, over the knife so that as the knife comes forward the hooks will be caught by it. The check on shaft is a star wheel setscrewed on the shaft. A small roll is held against the wheel by a spring, which holds the barrel securely after being turned. If this star wheel should slip the chain barrel will be on wrong time and as a result the pegs do not full under the index fingers and miss-picks result. The pawl may be set too low in slot of rocking arm and the chain barrel pulled over a little too far. In this case the check may possibly force the barrel to its correct position, but if it should fail to do this a miss-pick will result, because the barrel will not be in correct position. The remedy is to set the pawl higher in the slot and readjust the ratchet gear to the pawl.

Weak Spring on Chain Barrel Shaft.—The spring is held on shaft by a collar, which keeps the clutch in contact with the worm gear, this gear being loose on the shaft. If the spring should become weak, the clutch will be forced out of connection and chain barrel will not be turned. It occasionally happens when a large number of pegs are put in one chain bar that the check is forced out when the spring is weak. The remedy is to move in the collar which tightens up the spring.

Harness Levers Too Tight.—The harness levers should not be too tight or they will bind. They should be just tight enough to drop of their own weight before the harness shafts are attached to them. This is regulated by set screws on the front and back of the dobby frame. The ends of these set screws are in contact with the bottom portion of an harness lever, and by turning these set screws in or out the desired movement of the harness levers can be obtained. Also, neglect in oiling will cause them to bind.

Jack Hook Binding.—If a jack hook fits too tight on the jack where hook is connected, it will cause the hook to bind. This will keep the hook from dropping over the knife and harness shaft will not be raised. The end of the jack can be opened a little with a screw-driver, but care must be taken not to open too wide or it will catch on the end of the next jack when returning, and this keeps the threads from being lowered to their regular position and makes a miss-pick as well as causing them to be broken out. The jack with the opened end will be raised by the next jack when it ought not to be, and this often causes threads to be broken out. The best method to ascertain whether the miss-pick is caused by the jack hook binding is to raise up the hook and it should drop of its own weight. It will do this if working free. If a jack hook touches or comes in contact with the guide it is often prevented from dropping. In some cases the hook drops, but too late to be caught on the knife, and the harness shaft is left down when it ought to be raised.

Index Finger Binding.—An index finger occasionally touches or comes in contact with a pin in pin-board or the index finger guide. This prevents the finger from dropping and a harness shaft is raised when it ought not to be. This can be prevented by setting the index finger so that it will

pass clear between the pins or guide. Another cause of finger binding is given in "Requirements of a good dobby."

Chain Bar Too Short.—Occasionally a chain bar is a little shorter than it ought to be. This allows the bar to slip about on the barrel and causes a peg to get in between the index fingers, especially if the peg should happen to be a little crooked in the bar.

Chain Bar Too Large.—Occasionally a chain bar is a trifle too large. The bar will fit tight in the chain barrel and instead of dropping from the chain barrel is taken around with it and the chain gets stuck.

Peg Too Short.—Occasionally a short peg is put in the chain. The index finger in not raised high enough, consequently the jack hook is not lowered sufficiently to be caught on the knife.

Bent Connecting Links.—Chain bars are connected to each other by small links. Often additional bars have to be added, and when connecting them together these small links are bent, and this in many cases brings the bars a trifle closer than they ought to be. The result is that the bars will occasionally bind on the chain barrel instead of dropping off, and this causes the chain to get stuck.

Chain Bars Too Far Apart.—If the connecting links are not pressed together as close as they should be, the bars will occasionally ride on the barrel, which causes a miss-pick. This often happens when chain bars are tied together with twine on account of the knots slipping.

Chain Barrel Not Turned Over Far Enough by Pawl.—If barrel is not turned over far enough by pawl, the pegs will not be in correct position. The check sometimes forces the

barrel to correct position, but if it fails to do so a miss-pick results.

Worn Index Finger and Index Finger Rod.—If the rod which passes through all the index fingers is worn the fingers will not work steady, or if the index finger bearing is worn the result will be the same, there will be too much lost motion. The principal reason for the bearing or rod wearing out is neglecting to oil these parts. This fact cannot be emphasized too strongly. The only remedy is to insert new index finger and rod.

Other Causes.—Unequal springs on harness shafts will cause miss-picks. Poor filling will also cause miss-picks or perhaps a better term for this is broken picks. The filling will break and catch again on the same pick and this shows a broken pick in the middle of the cloth. This occurs mostly on fine work.

CHAPTER IX.

PICK AND PICK LOOMS.

These looms are called pick and pick looms because there are four boxes on each side of the lay and both picker sticks are picked at the same time. Having four boxes on each side of the lay an odd number of picks can be inserted. This is very convenient and necessary when a single pick of a certain specified color has to appear in the cloth at certain intervals.

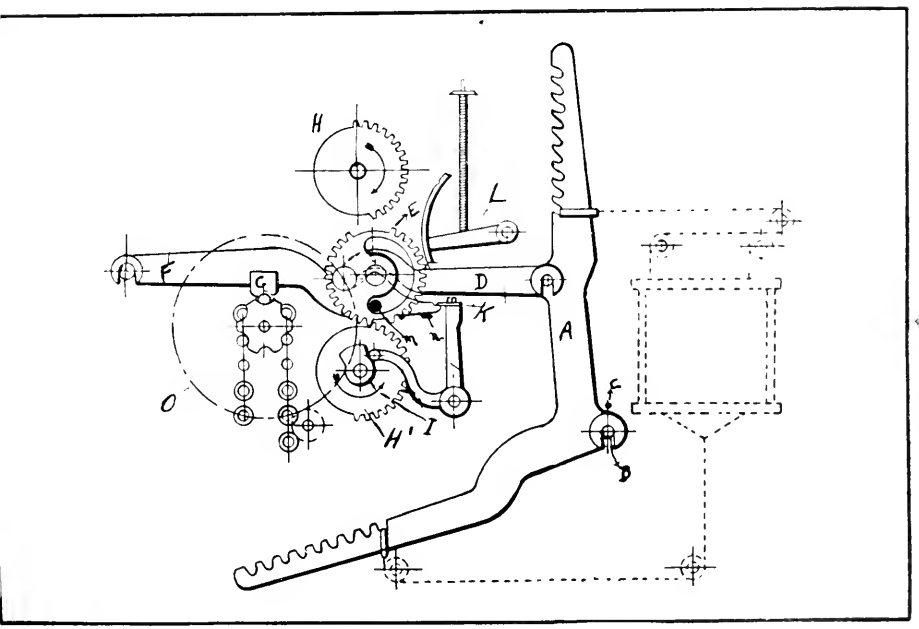

Fig. 18.

Head Motion.—The working parts of the head motion on one of these looms is illustrated at Fig. 18. This motion is specially adapted for weaving light weight worsteds, also cot-

ton fabrics. The construction and description of this motion is as follows:

The harness lever A has an equal number of notches on both ends, and these are for the purpose of regulating the size of shed. Each harness shaft requires a harness lever, and the harness shaft is connected to the top of the lever through connections, by a loop, and also at the bottom in the same manner as indicated by dotted lines in sketch.

The loops can be put in any of the notches, but they must be put in to correspond, that is, if the loop on top is in first notch the loop at bottom must also be in first notch. This will make an equal-sized shed, viz: the harness will be raised and lowered an equal distance. The front harness shafts are operated from the bottom notches, gradually being stepped for the back harness shafts.

The harness lever A is pivoted at the point B, and the harness is positive in both directions of its movement. The rod C, which extends from front to back of the head motion frame, prevents the levers from jumping when they are in motion. The harness lever is connected to the vibrator gears by a connecting arm D. This arm hooks on the harness lever at one end and is connected to the vibrator gear by a small stud, which allows freedom of motion to the gear. The vibrator gear E is connected to the vibrator lever F by a small stud in the center of the gear, and the gear works free on the stud. The chilled run G is riveted to the vibrator lever. The risers in pattern chain operate on these to raise the vibrator lever and gear. This run also prevents the lever from being worn. H and H^1 are the cylinders; I, the cam that works the lock knife K; L, the drop weight. The position of the harness lever and vibrator gear in sketch shows the harness raised. The cylinders rotate in the direction indicated by the arrows.

On the top and bottom of the vibrator gears an empty space

is made by leaving out some of the teeth. When the harness lever is in its normal position—the harness at the bottom—the narrow, empty space, which is equal to the space occupied by one tooth, will be on top, and the wide, empty space, which is equal to the space occupied by four teeth, will be at the bottom. In this position the stud which connects the connecting arm to the vibrator gear will be on the front of gear nearest harness lever, and the slotted half circle in the vibrator gear will be at the back. This slotted half circle works around a projection marked "m" on the vibrator lever, and the extreme ends of the slotted circle are held against the projection when the gear is turned forward or backward, as this is the distance the gear is required to be turned. This allows the stud that connects the connecting arm D to the gear to be a little below the centre, and the drop weight L being held against the connecting arm by the spring, prevents the gears from jumping while the loom is running. The large gear O is fixed on the end of the chain barrel shaft by a soft-pointed set screw, so that if the chain or anything about the chain should get stuck, the soft point will allow the gear to turn and breakages will be prevented.

Operation of Head Motion.—When the harness shaft is at the bottom of the shed, the small empty space in the vibrator gear will be on top, and the slotted half circle in the gear at the back. The vibrator lever is then resting on a grate at point marked "n," which extends across the frame of the motion. The wide empty space at the bottom of the vibrator gear allows the bottom cylinder to revolve without coming in contact with any of the teeth. To raise the harness shaft, a riser comes under the chilled run G on the vibrator lever, and this raises the vibrator gear sufficiently for the teeth in the top cylinder to come in contact with it, and the gear will be turned over to the position indicated in the sketch.

To return the harness shaft to the bottom of the shed, the riser is taken from the bar in the chain, which allows the vibrator lever to drop and rest on the grate at "n." The vibrator gear is then low enough for the bottom cylinder to come in contact with it, and the gear is turned, which lowers the harness shaft. The bottom cylinder is shown in Fig. 18 in contact with vibrator gear.

Timing of Head Motion.—When the crank is just behind bottom center have the first tooth of cylinder in contact with first tooth of vibrator gear.

LOCK KNIFE.

The purpose of the lock knife is to keep the vibrator levers rigid while the vibrator gears are rotating. When a riser comes under the chilled run G on the vibrator lever, the lock-knife finger must be on the extended portion, or on the highest part of the cam which causes the knife to be out, and this allows the vibrator levers to change. When the low part of the cam comes around, a spring immediately pulls the lock knife between the ends of the levers, and this holds the levers down.

Timing of Lock Knife.—The timing of the lock knife is to have the finger on the center of the extended portion of the cam when the vibrator levers are crossing each other, that is, changing from one chain bar to another. Another method of setting is as follows: Turn the chain barrel so that the vibrator levers will be full open, and have the lock-knife finger just about to drop into the depression.

HARNESS LEVELLER.

This leveller is a rod that extends from the front of the head motion frame to the back, and is directly in front of the

grate X in which the ends of the vibrator levers rest. When it is necessary to level harness shafts, for a pick-out or to draw in a number of threads, this leveller is used. By raising the leveller, all the vibrator levers and gears are raised, and then by turning around the cylinders, by an handle fixed on front of top cylinder shaft, the top cylinder comes in contact with all the vibrator gears, and the harness shafts are levelled.

REVERSE MOTION.

This motion is to reverse the direction of the chain, so that the right pick and box can be obtained if the filling should break and the loom run one or two picks before stopping, also to turn back the chain after a pick-out. This motion is driven from the shaft of the bottom cylinder, which extends out about two inches, and has a spline in it. On this shaft are two loose gears, one of 14 teeth and the other of 17 teeth, which are also splined to correspond with the shaft. The spline is for the reverse key to slide in and out. These gears are held on the shaft by a collar. Directly above the two gears mentioned is a compound gear of 14 and 17 teeth respectively, the two gears of 14 teeth being meshed into the gear marked O on the end of chain barrel, Fig. 18, but the two gears of 17 teeth are meshed into each other. The reverse key has a projection on the end of it, and when the head motion is running the key is in as far as it will go. This causes the bottom small gear of 14 teeth to give the forward motion to the chain barrel. To reverse the motion, the key is pulled out as far as it will come, which brings the projection on the end of key into the spline of outer gear of 17 teeth. This gear being meshed into the outer of the compound gear reverses the direction of the chain barrel.

MULTIPLIER MOTION.

This motion is to economize in space and to save time in the building of box chains. The changing of this particular motion is accomplished by an extended bar in the box chain. The shaft of the pattern chain barrel extends beyond the back of the head motion frame. The box chain barrel is mounted on a sleeve that fits on the shaft of the pattern chain barrel. On the end of the sleeve a star wheel is attached. On the same shaft is another sleeve which has a star wheel and a notched flange that carries the multiplier chain attached to it. The star wheels are driven by pin gears that are directly under them. To start the multiplier, an extended bar is put in the box chain, the extension passing under a finger, which is connected by a series of levers to the pin gear that drives the star gear on multiplier chain. This will start the multiplier, which will continue to work until a riser comes up on the chain, which will bring the inner pin gear in connection with the star wheel on box chain barrel and start up the box chain. Whenever an extended bar is used the multiplier will work.

HAND DISCONNECTOR.

The purpose of the hand disconnector is to disconnect the head motion from the driving gear so that when the filling breaks and loom runs for one or two picks before stopping, the pattern and box chains can be reversed to find the right pick. This motion is illustrated at Fig. 19. An eccentric gear A is set-screwed on the crank shaft and meshes into another eccentric gear B that carries on its face a bevel gear. This bevel gear is meshed into clutch gear C. Clutch gear C is divided into three portions. The middle portion is securely fixed to upright shaft D. The top and bottom portions are loose on the shaft. The top portion has a pin connected to it long enough to pass through the middle and into

the bottom portion, and this makes the three portions act as a solid gear when loom is running. The cylinders E are driven by bevel gears fixed on the upright shaft D and ro-

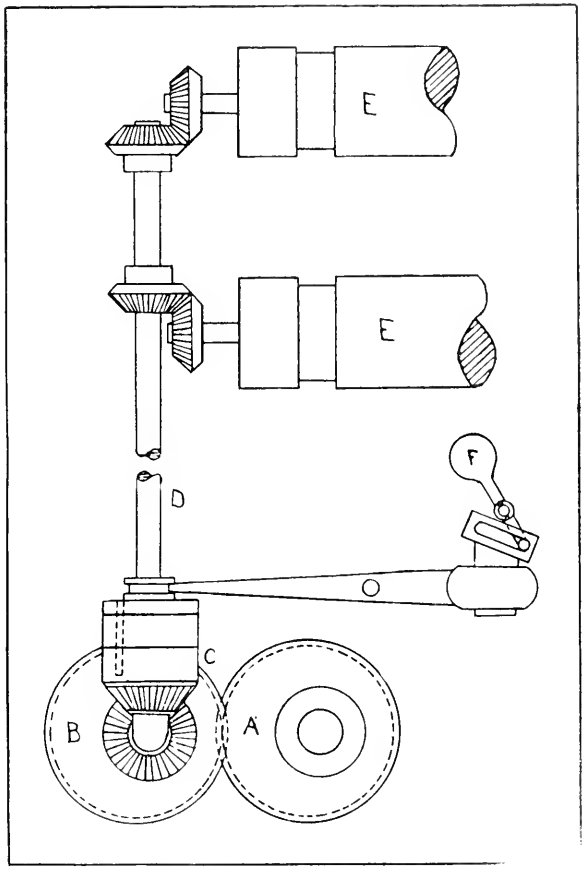

Fig. 19.

tate in opposite directions. When the chain has to be turned back to find the right pick, the handle F is pulled back, which raises the top portion of the clutch gear and this pulls the

pin out of connection with the bottom portion of the clutch gear and the head motion is disconnected from the loom. The reverse motion is set and the top cylinder turned by handle fixed on the front of the shaft until the right pick is found. The handle F is then pushed back and the pin passes into the bottom portion of the clutch gear, making one solid gear, as shown in figure.

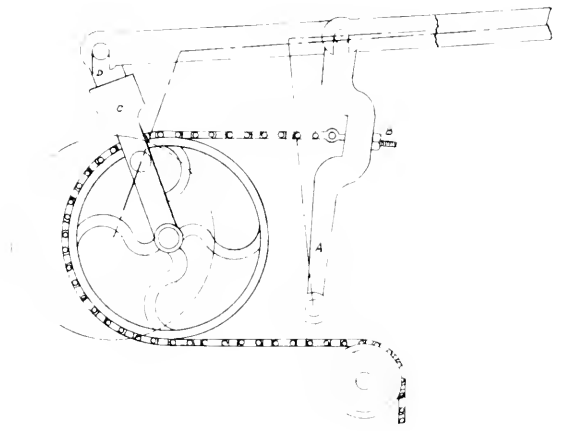

Fig. 20.

BOX MOTION.

This motion is illustrated at Fig. 20. The boxes are raised by means of levers and chains connected to the head motion. These levers are worked from the head in the same manner that the harness levers are worked. Two connecting arms are required to raise four boxes, the short arm to raise one box, the long arm to raise two boxes. The chain begins at point marked B on lever A and passes around a series of pulleys to the bottom of lifting rod of boxes, where it is connected. When the boxes are in their normal position, viz,

top box opposite race place, the lever A is in position indicated by dotted lines with lever C in its present position. The levers A and C in figure show the position of levers when a single box has been raised. A direct pull on the chain is made when lifting for a single box. When raising two boxes, the long connecting arm is pulled forward, which brings the lever C in position indicated by dotted lines. With the single lever as at A, the fourth box will have been raised, but with lever A, as in dotted line, the third box will have been raised.

Regulating Lift on Boxes.—The lift on single box is regulated by moving the adjustable nut B on end of chain up or down the slot in lever A. If boxes raise too high, lower the nut; if too low, raise the nut. The double box is regulated by adjustable connection B in lever C. If boxes do not raise high enough the connection must be lowered, but if boxes are raised too high the connection must be raised.

Timing of Box Motion.—When the crank has just past bottom center, have the first tooth of box motion cylinder in contact with vibrator gears, or when crank is just past top center, have the driving pin in connection with the star wheel.

CYLINDERS.

The cylinders E, Fig. 19, are divided in two portions, one to work the harness, the other to work the boxes. The portion that works the boxes is set about three teeth behind that which works the harness. This will allow the harness to change and be in position to receive the shuttle as it leaves the box; also if the boxes were changed at the same time as the harness, considerable trouble would be experienced in running the shuttle, which would cause it to chip.

FILLING STOP MOTION.

Fig. 21 illustrates the stop motion used on a pick and pick loom. This is a center stop motion and is in the middle of the lay, so that the loom will stop immediately when filling is broken. It is constructed as follows: Upright rod A is

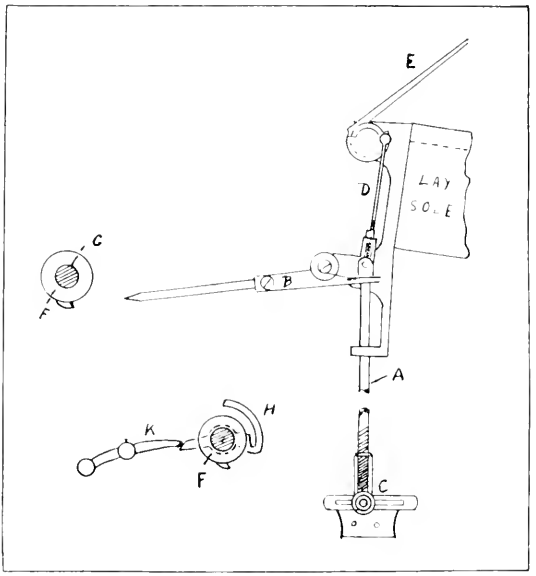

Fig. 21.

directly under the back end of filling motion dagger, B. The bottom end of the rod is attached by a stud to a slotted bracket at C. This rod is threaded at the bottom and can be raised or lowered. A small connection D connects the filling motion, dagger B, to cam on stud that carries the filling feeler wires E. F, is the receiver fixed on brake rod G. Illustration shows position of filling feeler wires when lay is on back center. A slot is cut in middle of lay to allow the feeler wires to pass into when filling is broken. The filling is laid under

the feeler wires by the shuttle, and as the lay comes forward the feelers descend but are kept from entering the slot by the filling, and the dagger passes under the receiver. When filling is broken, the feeler wires descend into the slot and filling motion dagger strikes the receiver and loom is stopped immediately. To enable the loom to be turned over by hand when necessary, a shield H is arranged so that it will drop in front of the receiver and the filling motion dagger does not connect. This setting of the shield on the brake rod, as illustrated in lower portion of figure, is not exactly as it appears on loom, but is here given to make the explanation clearer. The shield, which is about two inches wide, is centered on the brake rod G and is operated by the finger K. This finger, which is heaviest at back end, is fixed in the center to a heavy wire rod that extends under the breast beam to the side of loom, this end being directly behind the shipper handle. When shipper handle is pulled back to start up the loom, it comes in contact with the wire rod and this causes the end of the finger H to force down the extension on shield, and this will raise the shield above the receiver. When loom is stopped the shield is released and drops in front of receiver so that loom can be turned over by hand. Illustration shows position of shield when loom is running.

A foot release is connected to the brake rod at side of loom. This release is for the purpose of releasing the brake on the loom. At the extreme end of the brake rod a small finger is set-screwed, and when the foot release is pressed down the finger forces forward a lever fulcrumed on its center, which releases the brake on the loom and brings the receiver directly in front of dagger.

Timing of Filling Stop Motion.—With crank shaft on bottom center have the dagger in contact with receiver and feeler wires just above the race plate. Adjustment for lift of feeler

wires is made by upright rod A. When this rod is vertical, the feeler wires are at the highest point and crank shaft has passed the back center. By moving the rod in the slot at C or by adjusting the rod at screw connection the lift of the feeler wires can be changed.

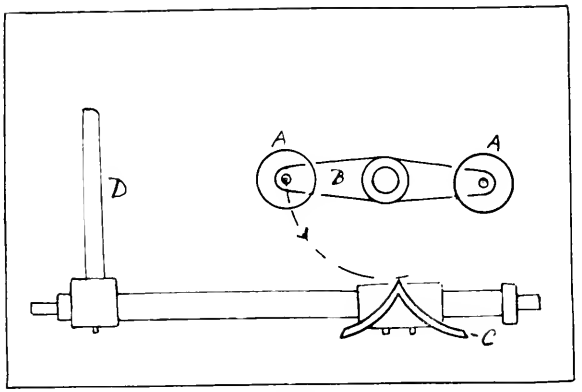

Fig. 22.

BAT WING PICK.

This picking motion is also called the ball and shoe pick illustrated at Fig. 22. The balls A are fixed on end of arm B. As the arm is on pick can shift a ball comes in contact with the shoe C every pick. The shoe is constructed so that there will be a gradual incline from the bottom to the top point. The ball first comes in contact with the end of shoe and travels up the shoe. The pick begins slowly, increasing in speed and finishes with a good firm pick. The shoe can be moved backward or forward on the shaft, but for best results it must be set so that the ball will come in contact with the whole of the shoe, beginning at the bottom and travelling to top. If the shoe is moved backward the ball will strike near the top thereby causing a sudden pick. If the shoe is set too far in, a harsh jerky pick will be given,

which is very detrimental to the picking motion. The arm D is connected by lug straps and sweep stick to picker stick as in an ordinary drop box loom. When the loom is picking, the arm should be in line with the picking stick. The lug straps should be set as near level as possible.

CHAPTER X.

BOX CHAIN BUILDING FOR PICK AND PICK LOOMS.

As previously stated, in a pick and pick loom there are four boxes at each end of the lay, and both picker sticks are picked at the same time; therefore, it is not necessary that the shuttle be picked back again into the box from which it first started before a change of boxes can be made. The great advantage that a pick and pick loom has over an alternate pick loom, or in other words, a gingham loom, is that a single pick of any color can be put in the cloth at any time, whereas in a loom that has drop boxes only on one side and which is an alternate pick loom only even number of picks can be put in the cloth of any color. It must always be remembered that on every pick in a pick and pick loom there must be an empty box at one end to receive the shuttle that is being picked from the opposite side, otherwise the shuttles will meet in the middle of the shed which often results in a smash.

LAY-OUT.

A simple and easy method of obtaining the box chain for any pattern is to make a lay out as follows: Rule four lines of squares to represent the four boxes on one side, leave a little space, then rule again four lines of squares to represent four boxes on opposite sides, or, to save time, use a design paper with large squares. Mark on top of these squares the numbers 4, 3, 2, 1 and 1, 2, 3, 4. These numbers represent the boxes on each side, 4 is the bottom box, 1 is the top box. Then mark over the numbers the color of the filling. The object of making this layout is to obtain the best and easiest changes of the boxes when changing from one color to another.

To illustrate, a lay out is given at Fig. 23, for a box chain for the following pattern: 6 picks white, 3 picks blue, 2 picks red and 3 picks blue.

The colors in boxes are arranged: white, first box, R. H. side; red, first box, L. H. side; blue, third box, L. H. side.

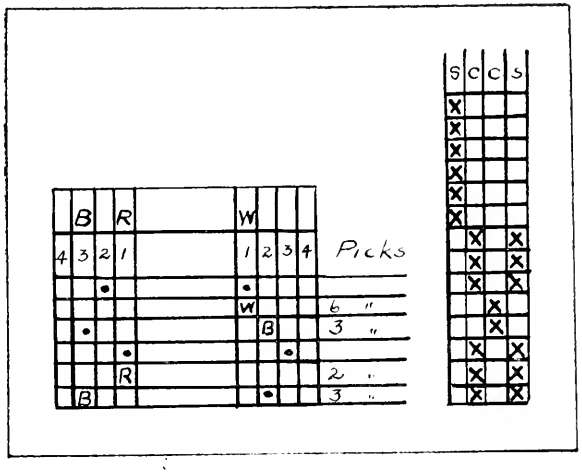

Fig. 23 and 24.

Pattern calls for six picks white, this color is in the first box, R. H. side, so must be picked across to L. H. side and back again for six picks. Indicate by a dot, the box the shuttle has left; also indicate by a dot the empty box the shuttle enters on opposite side, this is for the first pick. For the second pick the shuttle can be brought back to the box from which it started. As there are an even number of picks the shuttle will remain on R. H. side, so that the box in which the shuttle remains can be indicated by W, which is the color of filling. This will have to be repeated three times, but to save time the number of picks can be indicated at the side. Pattern now calls for three picks blue. The shuttle is picked from third box, L. H. side, to second box, R. H. side. As

there are an odd number of picks the shuttle will remain on R. H. side. This is indicated by B, and the number of picks at the side. Pattern now calls for two picks red. Shuttle is picked from first box, L. H. side, to third box, R. H. side and back again, as indicated by letter R, and number of picks at side. Pattern now calls for three picks blue. The shuttle is picked from second box, R. H. side, to third box L. H. side, and the number of picks indicated at side. This makes a complete repeat of the pattern, each shuttle is back into the box from which it started. From this lay out, the chain plan can readily be made as illustrated at Fig. 24.

S indicates single lever to raise one box, C indicates compound lever to raise two boxes.

When making a box chain there are a few points which, if remembered and kept constantly in mind, will greatly assist in the even running of the loom. First, when the boxes at both ends are changing together it is advantageous to have the boxes on one side lowered while the boxes on the opposite side are being raised. Second, as the time allowed in changing the boxes is the same for a large lift as for a small lift, it is necessary to have the lifts as small as possible, that is, avoid a lift of three boxes whenever possible. Take a simple illustration of changing the boxes when both sets of boxes are changing at the same time. A fabric requires two colors, say black and white, colors to be inserted pick and pick.

There are two methods of working the boxes for this pattern. Have the shuttles in first and second boxes R. H. side, black filling in top box, white filling in second box.

First method: 1 R. H. to 1 L. H., black; 2 R. H. to 2 L. H., white; 1 L. H. to 1 R. H., black; and 2 L. H. to 2 R. H., white.

Second method: 1 R. H. to 2 L. H., black; 2 R. H. to 1 L. H., white; 2 L. H. to 1 R. H., black, and 1 L. H. to 2 R. H., white.

In the first method the boxes are raised and lowered together. In the second method, a box on one side is lowered while a box on the opposite side is being raised. The strain on the loom when changing boxes by the second method, will be uniform, and the loom will run evenly. Much depends on the manner in which the shuttles are placed in the boxes. If when making a layout for a box chain the boxes do not change uniformly, by changing shuttles in boxes satisfactory results can generally be obtained.

MULTIPLIER.

The multiplier bar in box chain on this loom is an extended bar. This bar is about one-half inch longer than the ordinary bar in box chain. This extra length passes under a lever, which, through a series of levers, starts up the multiplier chain. The chain will continue to work until a riser comes up, which will again start up the box chain. This multiplier is a single-pick multiplier, that is, each bar in the chain represents one pick, so that the number of empty bars on the chain and the bar with a riser on it will be the value of the multiplier. In other words, when an extended bar is put in the box chain the multiplier is started, and if there are nine empty bars and one bar with a riser on it, the value of the extended bar will be ten picks. The multiplier can be made to multiply for any number of picks. The advantage in using a multiplier is in the fact that there is an economy in space, because a long box chain is dispensed with that would otherwise be required; also there is a considerable saving in time, which, if anything, is more important than the saving of a large box chain.

The multiplier is only used when a number of picks of the same color are required to be put in the cloth together.

To illustrate this principle, a lay-out and chain plan is

given at Figs. 25 and 26, for the following pattern: 1 pick green, 6 picks white, 2 picks black, 6 picks white, 3 picks drab, 6 picks white, 2 picks red, 6 picks white. M in box chain indicates Multiplier. A X under M represents an extended bar, empty square under M, an ordinary or short bar. In other parts of chain, X represents risers. Empty squares sinkers. A six pick multiplier is used. If multiplier

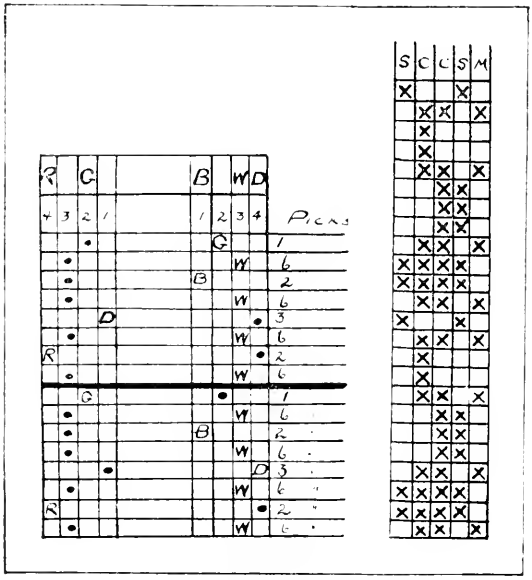

Fig. 25 and 26.

had not been used, 64 bars would have been required. At the end of a repeat in any box chain the shuttles must be in the boxes from which they first started, otherwise another repeat will have to be made. In this example at the end of one repeat the shuttles are in boxes as follows: L. H. side, drab in first box, red in fourth: R. H. side, black in first box, green in second, white in third. Another repeat is made in order to bring shuttles back to their right boxes at the end. First repeat is indicated by heavy line.

CHAPTER XI.

HEAD MOTION FIXING POINTS.

Miss-Picks.—A number of the causes of miss-picks will be given. These miss-picks cause defective work and are often seen in finished goods.

Links on Chain Bars Wrong.—The links should be put on both sides of the chain bar regular, viz: one outside, one inside. Sometimes they are put on the bars with one end of link outside and the opposite end inside of next link. This causes the chain to get stuck, and chain bars are often sprung.

Sprung Bars.—Sprung or bent bars are often very hard to detect, and require close watching, but they are a frequent cause of miss-picks. The bars should be straightened, but when this can not be satisfactorily done a new bar should be substituted.

Worn Bars.—The bars can be worn in different places. First, at link end. Such a bar should be replaced immediately as there is always the tendency to cause miss-picks. Second, by the riser wearing grooves in bar into which it sinks. The only remedy is to replace with new bar.

Worn Riser.—This will have about the same effect as the worn bar. The riser will sink too low on the bar and fail to operate the vibrator lever. A new riser should be used. The risers often become worn at the sides of the hub, and this allows too much freedom on the bar, especially if the sinkers or blanks are also worn. When this occurs a very liberal use is made of twine to patch up. The proper way is to replace the old risers and sinkers with new ones.

Worn Links.—These allow too much play of chain bars, and as a result the bars are not always on proper time or in correct position, and miss-picks occur. The holes being worn oblong allow the bars to become too far apart. The holes in bars should be perfectly round.

Short Links.—Occasionally a short link is mixed with the regular sized links. When this happens, a miss-pick is almost certain to result. The chain bar instead of dropping in the notch of the flange on chain bar, is held outside, and this not only causes a miss-pick but is often the cause of the chain bar being sprung.

Bent Links.—All links should be perfectly straight. If from any cause the links are bent, miss-picks will result. They are often bent at one end and also bent in at the hole through which chain bar passes. This holds that particular bar tight, and as a result instead of dropping from the chain barrel is taken around with it, and this causes a doubling up of the chain.

Loose Chilled Run.—When the chilled run is loose on the vibrator lever, the run is apt to be caught by the next riser which causes the wrong harness shaft to be raised.

Chain Barrel on Wrong Time.—If the chain barrel is on wrong time miss-picks will result.

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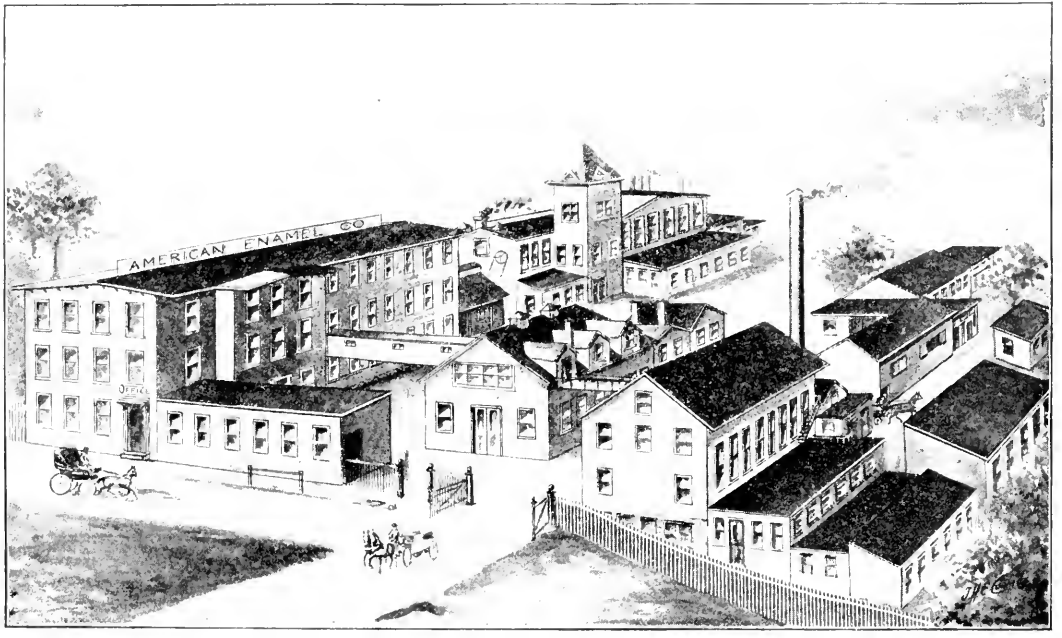

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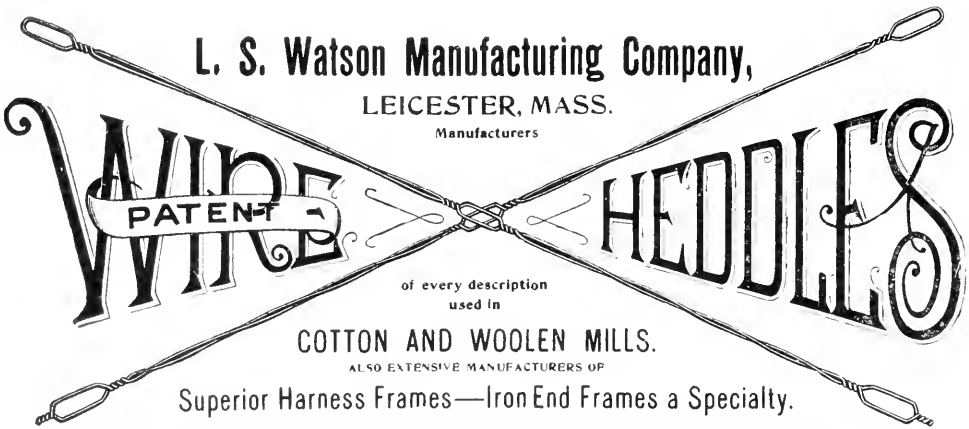

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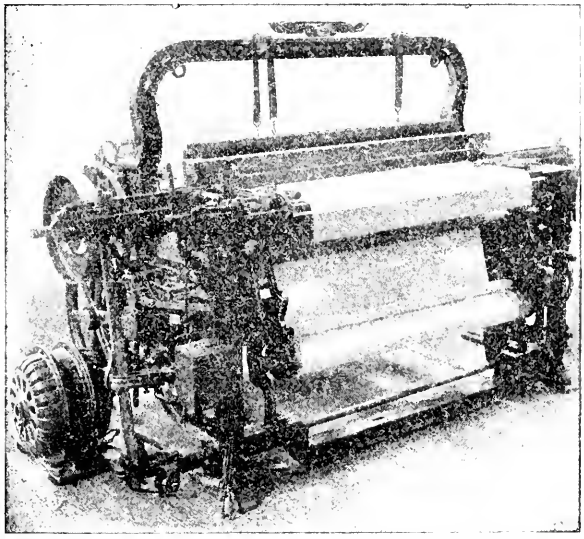

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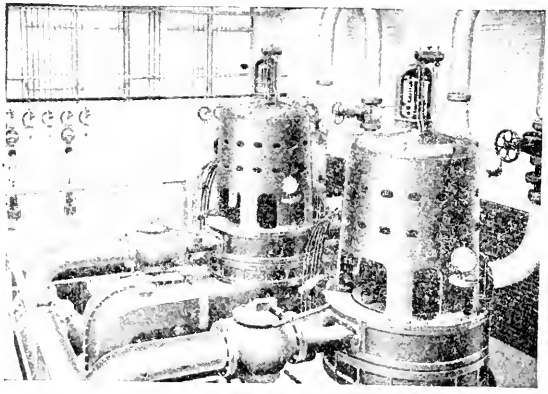

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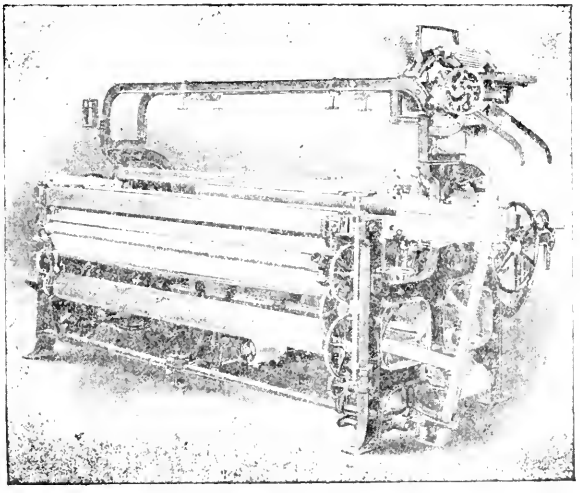

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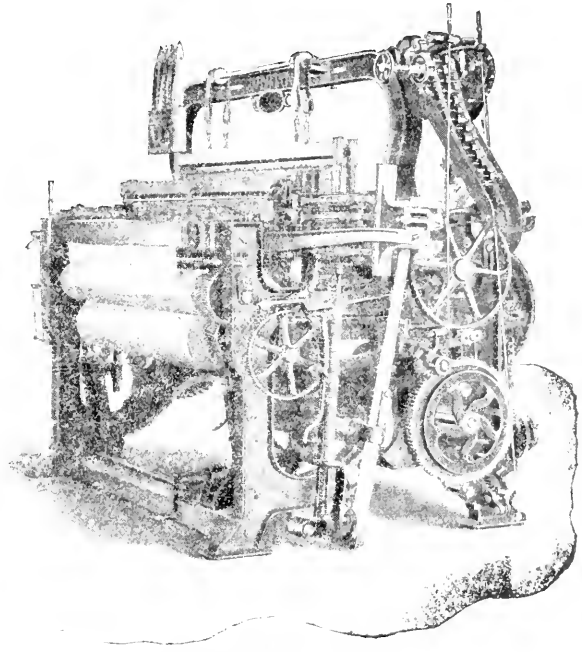

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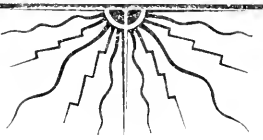

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